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TECHNOLOGY AND MATERIAL PROGRESS[1]

By Dr. WILLIS R. WHITNEY

DIRECTOR OF RESEARCH LABORATORY, GENERAL ELECTRIC COMPANY, SCHENECTADY

THERE is nothing in fixity. It is a figment of the imagination. The fact is old, the discovery is modern. Progress and not product dominates mankind. This has always been a changing universe. Perhaps the cave-man noted no change, but nevertheless its continuity had already been long established. Nowhere in the widest stretches of astronomical time is there any sign of one changeless period. The starry firmament itself has only been known to us through its changes. We interpret rays from the stars as proof that the most stable things on earth, our very elements, are being reduced and produced. The atoms are wireless stations which broadcast information of changes quite beyond our earlier comprehension.

Continuous change marks not only celestial systems and our inorganic worlds, but every living thing, from polyp to politician. All have developed by change and are still changing.

The single living cell which first slipped the hawser that anchored it to some submarine rock hopefully wiggled its residual stump, or cilium, and, thus experimentally moving about, found it could better meet its food half way. Thus changes for good in life may be due to an unsatisfied, but not necessarily dissatisfied previous state. Being unsatisfied or inquisitive is not safety first, and in the Devonian age many an experimenting fish must have died at low tide before satisfactory lungs were developed.

Certainly the persistence of change, the absence of fixity which is so evident to-day, must have been seen by early philosophers, though I suspect that the possibilities in change, nay, the certainty that changing, or progress, is the all-important thing, had not been

[1] Presented at the general meeting of the American Philosophical Society, Philadelphia, April 23, in the symposium on "Tendencies in the Natural Sciences in the Changing World."

discovered at the time of Socrates. I find him saying in Plato's "Republic" something which is not further expanded. In considering the possible source or training of leaders for the republic, Socrates asks briefly, "What sort of knowledge is there which would draw the soul from *becoming* to *being?*" I am supported by Jowett's notes on the "Republic," which contain this significant reference: "The regular *growth* of a state enlightened by *experience, progressing* in knowledge, improving in the arts of which the citizens were *educated* by the fulfilment of political duties, appears never to have come within the range of their hopes and aspirations."

Our knowledge of nature's laws is always incomplete and ragged. Man-made laws are imperfect and inconclusive. The edges of all human fabrics are rough and frayed. Our inventions and devices are like little islands rising from an infinite ocean, or like living trees in fertile fields growing at all exposed surfaces. All sciences are adding new science at the tips of countless branches to-day, and must always do so. This fact in turn becomes a necessary and inseparable part of our technology and material progress.

Once the men of every race were less appreciative of their possibilities of change and more deferential to powers in lower animals. Every country, every tribe and almost every family at one time adopted, and even worshipped, some lower animal. So we have the American Eagle, the Russian Bear, the British Lion, the Mohawk Turtle, the Egyptian Scarab, the Chinese Dragon, etc. Francis Bacon attributed to Herodotus the view that the Egyptians deified many animals because they were so much better discoverers and inventors than men. It is as though inquisitive change was recognized in lower animals long before man saw any direct possibilities in discovery for himself.

In some respects, the beginning of advancement of science might be attributed to the twelfth and thirteenth centuries. At that time (or even earlier), foreign students in European cities, living abroad to acquire new knowledge in medicine, religion, civil customs, etc., were forced to protect themselves by forming organizations which became the universities. This process of international spread of knowledge has never been reduced, and some of our modern physical, chemical and mechanical processes and products are directly traced to researches in pure science, carried out entirely under university auspices. In other words, it was through the efforts of ancient organizations, themselves changing or progressing, that the scientific foundations were laid for our material as well as our spiritual progress. The process has become continuous and at no time has there been absence of a spiritual aim.

Having the possibilities of infinite change in mind, Bacon in 1600 wrote powerfully against the inactivity of men who were limited by fear and superstition, taboos and cumbersome words.

A change did, indeed, begin about this time. Men were encouraged to seek freedom from false gods, from mysterious words, from ancient traditions; unprejudiced attack by experiment and observation was suggested, and means for improved communication, for economical recording and preserving of truth were devised. Cheap printing was in vogue.

From then on even those institutions of highest religious aim turned gradually toward considering the lily, and to diligently questioning and enjoying study of the rest of the universe. Galileo and the first scientific society date about 1600. The British Royal Society (1662), the French Academy of Sciences (1666), the Berlin Academy (1700), and the American Philosophical Society (1769) followed this great change. Gradually the universities all over the world began devoting effort to progress in new knowledge. Not satisfied to be mere preservers or storehouses of collected wisdom, they learned by experiment and saw that there never need be a limit to advancement of knowledge. Its acquirement by direct attack soon took place in countless different directions, and in all civilized countries, and the whole orderly product received the title of "science." It is having such a broad influence that we need not expect man to move in cycles or circles. He is progressing rather in an ascending helix.

Without delving deeply into technology and material progress, I wish to introduce a few specific instances of this early perception. I have enjoyed noting the various ways in which men first commenced to express faith in progress. No other animal does it.

I like to think of pious old John Woolman, who would not allow his clothing business to expand lest it interfere with his spiritual growth, as being appreciative of progress. He believed it possible to "provide all men with an environment which will best develop their physical, mental and spiritual powers." This was not mere theory with him, for he sought to apply it when he helped prepare the way for changed treatment of the American Indians, and, over a century before the Civil War, fought earnestly for the freedom of the slaves.

Baron de Tocqueville, writing of the Americans in 1850, said:

> They have all a lively faith in the perfectability of man; they judge that the diffusion of knowledge must necessarily be advantageous and the consequences of ignorance fatal. They all consider society as a body in a state of *improvement*, humanity as a changing scene in which nothing is or ought to be permanent, and

they admit that what appears to them to-day to be good may be superseded by something better to-morrow.

He adds, cautiously, "I do not give all these opinions as true, but as American opinions."

Bearing on de Tocqueville's remarks, Mr. M. E. Tracy recently wrote in the *World Telegram:*

> To a great extent, we Americans have cultivated an insatiable thirst for change and innovation. We want nothing so badly as new methods and new devices. We are intrigued by nothing more distinctly than the thought that there is bound to be something different just around the corner. The appetite for experiment, discovery and invention is in our blood.

Modern philosophers, like Bergson and John Dewey, have advanced about as far as people are yet willing to follow in this view of progress. It is a bit novel to think of the process of change as more important than any finished product. We have naturally a thought of the importance of arrival, the imminence of the millennium. But arrivals are only rising steps of immortal growth where the worth-while thing is climbing, not resting. Bergson, in Creative Evolution, says, "We change without ceasing. To exist is to change, to change is to mature. Duration means invention, the creation of forms, the continual elaboration of the absolutely new." There is no sign of fixed states here.

John Dewey has said, "The vanity and irresponsibility of values that are merely *final* and not also, in turn, means to the enrichment of other occupations of life ought to be obvious." The process of growth, of improvement and progress rather than the static outcome and result become the significant thing. "Growth itself is the only moral end." "Not perfection as a final goal, but the ever-enduring process of perfecting, maturing, refining, is the aim of living."

In 1895 Professor William James heard a Harvard teacher say, "All the fundamental conceptions of truth have been found by science, and the future has only the details of the picture to fill in." Professor Wilhelm Ostwald had just expressed the same thought in Leipzig. James vigorously denied this theme and said truly, "Our science is a drop, our ignorance a sea." Since 1895, radium and the x-ray have been developed, the atom broken down, the electron discovered, Einstein's generalization produced, the quantum conception provided. Our bones are now made visible, we communicate with Europe by radio, television is in sight, aeroplanes have become common, and we admit that we know less about the essence of time, space, gravitation and light than was known in '95. Truly our ignorance is a sea, our knowledge almost an evaporating drop. But the fortunate thing is that we are still changing.

We see new industrial experiments carried on all around us, but do we realize that they constitute progress, and that this is more than ever possible through the magnitude of the experiments and the facility with which they are made public? From the remote concentration of human physical efforts in Russia and the unprecedented trials in England's dole, to our own internal novelties in the way of unemployment relief and veterans' bonus loans, the world is trying changes. And it is too early to compare with certainty the effect of the underpayment of the one with that of the overpayment of the others.

Our international technical possibilities are like the sinews of the child, not easily broken, but not yet tested or developed. We use radio for mere amusement and noisy advertising, our wealth for armies and schemes for destroying our neighbors. We can not change at once, but we realize that there is a gradual tendency to get together and to live in peace.

Count Keyserling, in his Paris lectures on the domination of the machine age, looks at our present civilization in the United States as the "tragic misconception of the modern epoch traceable to a failure to recognize that man is essentially spiritual." He may be right. But all former civilizations were still more tragic misconceptions, if knowledge and truth are criteria. There has never before been a time when a man, speaking on the banks of the Seine, was heard in the reaches of the Trocadero through mechanical amplifiers, and his words published all over the world on the following morning. In fact, if the spiritual leadership of such a man were evident even to a very small number of his fellows, his voice could be instantly broadcast to the world by devices which mark, as plainly as anything does, our machine age.

The speed with which we are applying new knowledge seems dangerously rapid to some, but there is every indication that it will not be reduced. An individual, or a nation, may decide that it has experienced a too rapid mechanical progress, but, as long as others advance, there will be an increasing tendency to bring all people to whatever has apparently (at least temporarily) proved to be the most satisfactory condition. In other words, it has always been, and probably will always be, a changing scene, with new experiments pointing a way to better conditions.

There never was a time when so many people in one nation, or so many nations of the world, were trying to advance. There never was a time when technical and material progress was more constructively attempted and critically examined. There never was a time when any one's efforts for good were so quickly and so generally broadcast. There never was a time when youth was more earnest or fearless in seeking the essentials of truth. The accumulated data of all material progress never were so great and never so

uniformly appreciated. If one country slackens in gaining new knowledge, the whole world knows it at once. If another country, or even any individual in it, advances the science of some particular field but a trifle, the rest of the world begins at once to use it. Pavloff's experiments in Leningrad on salivating dogs are quickly coordinated with psychological researches in America, and these in turn with brain mechanics, and then operators in highly mechanized manufacturing plants are experimentally chosen, graded or discharged according to reflexes and psychological reactions.

Those who are interested in technical progress look at it as continuous, but do not necessarily overrate its importance. There must be a parallel advance for the higher values in man. Perhaps the best way to look at our materialism is just as we now look at its earliest examples, for we are but a very short way from what may be called our real beginning as thinkers.

All the early discoveries which first insured bare preservation through continued effort were augmented by technical discoveries like tool making, food growing, fire building and animal control. These in turn were followed by time-saving and time-integrating developments like writing and printing. Our present accessories in electricity, mechanics and electronics, important because of proximity, are only the latest added steps, not the last. They lead to new kinds of people with new kinds of minds. This is what man at every previous stage has devoutly sought for, earnestly fought for and generally acquired.

There are errors in scientific conclusions now, just as there have been in the past. Hardly a single scientific fact of one century remains adequate for the next. First the world is flat and the sun rises; then the world is round and the world goes around the sun. Then the whole system moves through infinite space towards Alpha Centauri, and then the space loses its infinite quality and adds a curvature. I don't expect to see the end of changes, nor will any one else, because the last man will insist on making them while he improves. Our conceptions, discoveries and uses of an unfathomable universe are certainly always flexible and subject to improvement.

I think the world is more anxious to go right than ever. It is more eager to develop intelligently and not stop at some temporarily agreeable state. It is learning that any conceivable fixed state is not worth while so long as we still possess the power to advance.

It is futile to expect a world which is already enlightened to the advantages of material knowledge, mechanical substitutes for physical labor, and the promise of freedom for better growth in the future, to reduce its efforts or change its direction.

Man *is* essentially spiritual, but his tokens of values, his media of exchange, the flowers of goodwill to others, call for material (even mechanical) devices. The Greek slave, the Egyptian fellah and the man-with-the-hoe developed into the modern, less-enslaved philosopher who sees that man is essentially spiritual. If there is one thing modern mechanical civilization can do, it is to free people from slavery and strew spiritual opportunity along their path.

OBITUARY

EARL DOUGLASS

MY good friend and coworker in paleontology, Mr. Earl Douglass, died Tuesday, January 13, 1931, in a hospital at Salt Lake City, Utah, following an operation due to an attack of influenza, and other complications. Mr. Douglass had not been in good health for a number of months, in fact he was not in robust health last October when I last saw him at his home in Salt Lake City. However, the sudden and critical turn to his illness came as a distinct shock to his family, his many friends and colleagues.

Mr. Douglass was born in Medford, Minnesota, October 28, 1862, the son of Fernando and Abigail Louisa Douglass. He studied in the University of South Dakota, in 1888, and later took his Bachelor of Science degree at the Iowa State College, Ames. He studied in the Agricultural College and Missouri Botanical Gardens, St. Louis, and attended the University of Montana, where he took his master's degree. From 1899 to 1900 he taught geology, physical geography and physics at the University of Montana. From 1900 to 1902 he had a fellowship at Princeton University under Professor W. B. Scott.

In 1902 Mr. Douglass joined the staff of the paleontological section of the Carnegie Museum. At this time began my acquaintance and pleasant association with him, which continued uninterruptedly for nearly thirty years. His life was exemplified by conscientious and diligent work in all his undertakings, which was but slightly rewarded.

Mr. Douglass married in October, 1905, Pearl C. Goetschius, of Alder, Montana. One son, Gavin Earl Douglass, was born of this union.

Mr. Douglass's most famous field work was in connection with the Carnegie Museum when he discovered in 1909, and continued work for twelve or thirteen years in, the Jensen Fossil Dinosaur Quarry on Green River, northeast Utah. This quarry was finally taken over by the United States Government and set aside as a national monument. After this the quarry was

called the National Dinosaur Monument Quarry, without question the most famous dinosaur quarry in the world.

In 1924 Mr. Douglass joined the University of Utah and assisted in preparing dinosaur material, which he obtained from the famous Jensen quarry after leaving the Carnegie Museum in 1924.

Among the activities by Mr. Douglass the last year or two of his life may be mentioned his preparation of an exhaustive geological survey of the Barbour Asphaltum Company holdings of the hydrocarbon deposits in the Uinta Basin, Utah.

Mr. Douglass's activity in research was quite extensive. Besides many publications on economic geology and other subjects in various periodicals not easily accessible or even listed, there are some twenty-four titles recorded in the catalogue of the fossil vertebrates of North America by Dr. Oliver P. Hay.

O. A. PETERSON

CARNEGIE MUSEUM,
PITTSBURGH, PENNSYLVANIA

ERIK EKMAN—AN APPRECIATION

THE work of Erik Ekman as a botanist has been most competently recorded by a fellow botanist in a recent number of SCIENCE, and to that account I have nothing to add. It is rather to emphasize his unique character as a man and as an individual that a mere entomologist can hope to speak. A trained writer, such as Seabrook in his "The Magic Island," can give a not inaccurate account of how Ekman appeared to ordinary persons; yet without some knowledge of the fundamental impulses actuating his conduct and his outwardly unkempt mode of living, a true appreciation of his character is lacking.

In considering the historic figures who, in pursuit of a great purpose, have given up all thought of family and friends, wealth and position, worldly honors and distinctions, one should not forget the conflict in interests before the decision was made to forsake them all. Yet so far as one could judge of Ekman, there was no conflict, and never had been. He lived wholly and absolutely for botany, without thought of other considerations. When he importuned transportation to go on an extended field trip, there was nothing personal about his request. The mode of transportation and physical discomfort meant nothing, if only one would stop and let him observe and collect long enough at the desired localities. A fellow botanist, H. D. Barker, one of whose ambitions had long been to own and drive a Cadillac, took the two of us on a long trip across the border into the Dominican Republic, my own humble function being to hold tight and read the speedometer when Barker was fully occupied in getting 65, 70 and 72 miles an hour out of the venerable bus. At one point Ekman decided that a certain cactus might be sub-specifically different from that growing elsewhere in Hispaniola, and, to determine the point, he collected an abundance of material, which for safe-keeping was placed loosely in the back of the car, under his knees. For ordinary travel this was well enough, but when Barker really began to push the car over rough roads, Ekman yelled that the cacti were pricking him. No wonder, yet it never occurred to him to throw them out until two or three days later, when they could be compared with other material and the point at issue regarding their difference or identity definitely settled.

Travel by private automobile, however, was really exceptional for Ekman. He usually walked. Unhesitatingly, he often started out afoot on trips that would last for weeks, especially to the more inaccessible parts of the island. At times he was nearly barefoot because he had worn out the soles of his shoes. Never did he complain at what food and shelter for the night the humblest and poorest Haitian peasant could furnish.

But little as physical discomfort meant to him, even less did the opinions of others affect the mental atmosphere in which he dwelt. The thick-skinned pertinacity of a "go-getter" salesman was as nothing compared with the indifference of Ekman to what those who were helping him collect might think of him personally, or of his activities. Of course he might have smoothed his way of being less direct and outspoken in his statements of fact or opinion, but even such slight deviations from his singleness of purpose were not considered. Systematic botany was a wholly sufficient end, which must excuse any breach of ordinary etiquette by its devotees. My own requests for identification of the host plants eaten or infested by insects were always treated as only parasitic, and entirely accidental, by-products of a science complete in itself, while more obviously practical applications of his knowledge were hardly worthy of discussion.

No account of Ekman in Haiti is complete without mention of the sympathetic aid given by the kindly, white-haired German pharmacist, Buch, who took Ekman into his own household, cut a previously unnecessary window in a partition of an upper floor of his store, and fitted up a room where Ekman could work undisturbed and keep his material. At times when Ekman tended to devote too much time to field work, Mr. Buch insisted that he keep his herbarium in shape and continue to forward his material to Germany for more intensive study, comparison and description. Without some such quiet, self-effacing, appreciative person to organize Ekman's exceptional abilities, a large part of the tangible results accruing from his enthusiasms in toiling with heavy herbarium presses in the baking heat of Haitian deserts or in

the chill of rain-drenched mountain peaks would have been lost to science.

GEORGE N. WOLCOTT

ISABELLA SUBSTATION,
PORTO RICO

RECENT DEATHS

PROFESSOR GEORGE HERBERT MEAD, since 1894 connected with the University of Chicago, since 1907 as professor of philosophy, has died at the age of sixty-eight years.

THOMAS TARVIN GRAY, president of the Gray Laboratories of Newark, New Jersey, and well known as a consulting petroleum technologist, died on April 27. He was forty-nine years old.

DR. WILLIAM A. DRUSHEL, teacher of chemistry at Yale University from 1908 to 1918 and director of the research laboratory of the Haskelite Manufacturing Corporation from 1918 to 1931, died on April 17 at the age of fifty-seven years. Dr. Drushel is best known for his numerous research papers in certain phases of colloid chemistry and related subjects.

PHILIP R. LOWRY, assistant professor of economic entomology and assistant entomologist of the Experiment Station at the University of New Hampshire at Durham, died on April 30 at the age of thirty-five years, while working in the entomological laboratory of the university.

HENRY F. HOLTZ, associate professor of soils at the Agricultural Experiment Station, State College of Washington, died on April 20.

FERDINAND F. CREVECOEUR, an amateur naturalist, who is the source of many plant, bird and insect records from Onaga, Kansas, died on April 7 at the age of sixty-nine years. He published nine articles in the *Transactions* of the Kansas Academy of Science from 1903 to 1922. A biography has been prepared for publication in the *Transactions*.

DR. JAMES LORRAIN SMITH, F.R.S., professor of pathology and for some years dean of the faculty of medicine at the University of Edinburgh, died on April 18.

THE death is announced of Dr. Wilhelm Valentiner, professor of astronomy at the University of Heidelberg.

SCIENTIFIC EVENTS

THE BERMUDA BIOLOGICAL STATION FOR RESEARCH

IN 1903 the Bermuda Biological Station was established under the joint auspices of Harvard University, New York University and the Bermuda Natural History Society, and it has been continued every year since that time under the directorship of Dr. E. L. Mark, of Harvard University. During all these years it has occupied rented property in Bermuda, and in spite of limited facilities about two hundred and eighty investigators have studied at the station and have published more than 160 papers on the work done there.

In 1925–26 the station was reorganized under a corporation consisting at present of 180 scientists and public-spirited citizens of the United States, Bermuda, Canada and Great Britain. A board of trustees, consisting at present of 20 residents of these countries, was elected by the corporation, and articles of incorporation were granted by the State of New York on June 28, 1926.

Committees of the trustees have visited Bermuda several times to select the best available site for the station and to secure the cooperation of the Bermuda Government. After careful investigation of many sites, and after the selection and subsequent abandonment of one of these, a property known as "Shore Hills" in St. George's Parish, near the northeast end of the Bermuda group, was finally chosen. The Bermuda Government contributed £5,500 toward its purchase on condition that the trustees secure £50,000 elsewhere, the Rockefeller Foundation met this condition, and on March 26, the Bermuda Biological Station took possession of "Shore Hills," one of the finest properties in St. George's Island.

The buildings are now being remodelled for laboratory and residential purposes. In the main building, which was formerly a sanitarium-hotel, there will be in the basement a physiological laboratory, with accommodations for five or six workers, an aquarium room, a dark room, a cold room and a chemical store room, as well as kitchen, laundry and other rooms for household purposes. On the first floor will be a large general laboratory 24′ x 40′ with accommodations for eight or more investigators, and eight private laboratories, all of them supplied with aquaria and running salt water, as well as with A.C. current of 110 volts. There are also on the first floor a living room, dining room, serving room and extensive verandas which can be used for laboratory purposes as well as for recreation. On the second floor are rooms for the library, twelve bath rooms and eighteen bedrooms, each with an outdoor sleeping porch; many of these can be converted into private laboratories if the need should arise. On the third floor are seventeen bedrooms, and four baths in addition to store rooms. The grounds of more than fourteen acres contain in addition to the main building five cottages,

an engine house, a bathing pavilion and boathouse, tennis courts and a portion of a golf course. On the whole, no more delightful place for residence and for scientific work can be found in the western Atlantic. The region around Shore Hills is peculiarly favorable for biological and oceanographical work. There is easy access to coral reefs and heads with their wealth of marine life and the deep ocean can be reached in a few minutes in three different directions. The station now possesses a small launch and several rowboats and a larger motor boat will be provided in the future.

It is expected that funds will be available to appoint a scientific director and staff and to keep the station open throughout the entire year, but for the present arrangements are being made for a session of eight weeks beginning on June 15. No formal instruction will be offered, but approved investigators and research students will be welcomed as far as accommodations will permit.

Room and board will be furnished in the main building during regular sessions at actual cost. Microscopes, special apparatus and unusual or costly chemicals that may be required should be brought by investigators; the station will supply the more usual apparatus, including glassware and chemicals, but no sales department will be maintained.

Bermuda is reached by two lines of regular steamers from New York as well as by other lines that are not so regular. Boats of the Furness Bermuda Line sail from Pier 95, North River, at the foot of 55th Street, Manhattan, every Wednesday and Saturday at 11 A. M. New York time. The usual time of trip is 48 hours or less. On reaching Bermuda those who wish to go to the Biological Station by the shortest and least expensive route should leave the steamer by the tender going to St. George and go from there to Shore Hills, one and a half miles distant, by carriage or launch. Workers at the station and their families can secure through the station reduced rates of transportation (first class) from New York to Bermuda and return. From May to December the round-trip ticket costs $40 plus the governments' taxes of $6; from December to May, $60 plus the same taxes.

In the distribution of duties for this season, Dr. Harrison has consented to look after the transportation of investigators from New York to Bermuda and return. Persons desiring to make use of the facilities of the new station should, therefore, apply as soon as possible to Professor Ross G. Harrison, Osborn Zoological Laboratory, Yale University, New Haven, Connecticut, for sailing accommodations, and information regarding equipment, clothing, etc.

THE SIXTH INTERNATIONAL CONGRESS OF GENETICS

THE year of 1930 may be considered as having been one of preliminary organization for the Sixth International Congress of Genetics, which will be held under the presidency of Dr. T. H. Morgan, California Institute of Technology, at Ithaca, New York, from August 24 to 31, 1932. The year of 1931 is being used to collect the basic financial resources on which the congress must depend, to plan the major features of the program and to work out ways and means for bringing invited Europeans to this country and for utilizing their time wisely after they have arrived.

The council of the congress consists of R. C. Cook, American Genetic Association, treasurer; C. B. Davenport, Carnegie Institution of Washington, chairman of the finance committee; L. C. Dunn, Columbia University, chairman of the transportation committee; E. M. East, Harvard University, chairman of the program committee; R. A. Emerson, Cornell University, chairman of the local committee; D. F. Jones, Connecticut Agricultural Experiment Station, chairman of the publications committee; M. Demerec, Carnegie Institution of Washington, chairman of the exhibits committee, and C. C. Little, Roscoe B. Jackson Memorial Laboratory, chairman of the council and secretary general of the congress. Monthly meetings have been held in New York.

A *Quarterly Bulletin* containing the latest reports on progress made is issued from the treasurer's office. Those interested can obtain copies by writing R. C. Cook, American Genetic Association, Washington, D. C.

Because of the time which must elapse before the congress, American memberships are still coming in very slowly. If such membership is taken out in 1931 it is at a $10.00 rate, which includes the printed proceedings, whereas, if it is delayed until 1932 the rate is $15.00. It is hoped that a reduced rate, without the privilege of receiving the published proceedings, will be offered to students who have not obtained their doctor's degree. The expenses incidental to the congress are being kept at an absolute minimum.

The congress will naturally provide much the same opportunity for invaluable international contacts as did the recent Physiological Congress at Boston. It is the plan of the council to have the congress complete and extensive, including a comprehensive series of exhibits from genetics laboratories throughout the country. Because of these facts it will undoubtedly draw all zoologists and botanists interested in any phase of experimental work.

Participation on the program will be by invitation only. Those interested in genetics should not, how-

ever, delay in joining until such an invitation is received. They should become members at once by getting in touch with the treasurer.

European members will be entertained in New York during the few days between the date of landing and the opening of the congress at Ithaca. Columbia University has generously agreed to cooperate in this matter.

For any particulars concerning the congress communications should be addressed to C. C. Little, Jackson Memorial Laboratory, Bar Harbor, Maine.

THE NATIONAL ACADEMY OF SCIENCES

AT the annual meeting of the National Academy of Sciences, which met in Washington on April 27, 28 and 29, the following officers were elected:

President—Dr. William Wallace Campbell, director emeritus of Lick Observatory.

Vice-president—Dr. David White, U. S. Geological Survey.

Home Secretary—Dr. Fred E. Wright, Geophysical Laboratory of the Carnegie Institution of Washington.

Members of the Council—Dr. W. B. Cannon, George Higginson professor of physiology, Harvard Medical School, and Dr. Roger Adams, professor and head of the department of organic chemistry, University of Illinois.

Professor P. Debye, director of the Institute of Physics at the University of Leipzig, was elected a foreign associate. New members were elected as follows:

Dr. Henry Bryant Bigelow, associate professor of zoology at Harvard University and curator of oceanography at the Museum of Comparative Zoology, director of the Institute of Oceanography at Woods Hole.

Dr. Edwin Broun Fred, professor of bacteriology, University of Wisconsin.

Dr. Edwin Crawford Kemble, associate professor of physics, Harvard University.

Dr. Adolph Knopf, professor of geology, Yale University.

Dr. Robert Harry Lowie, professor of anthropology, University of California.

Dr. Joseph Haines Moore, astronomer, Lick Observatory, Mount Hamilton, California.

Dr. Robert Lee Moore, professor of mathematics, University of Texas.

Dr. Hermann Joseph Muller, professor of zoology, University of Texas.

Dr. George Linius Streeter, director, Department of Embryology, Carnegie Institution of Washington.

Dr. Margaret Floy Washburn, professor of psychology, Vassar College.

At the annual dinner of the academy, over which Dr. Thomas Hunt Morgan presided, the Daniel Giraud Elliot medal for the most meritorious work in zoology or paleontology published during the year was presented to Professor Henry Fairfield Osborn for his monograph on "Titanotheres of Ancient Wyoming, Dakota and Nebraska," the presentation speech being made by Dr. William B. Scott, of Princeton University. The Mary Clark Thompson medal "for the most important services to geology and paleontology" was presented to Dr. E. O. Ulrich, geologist of the U. S. Geological Survey, the presentation speech being made by Dr. Rudolf Ruedemann, state geologist of New York.

SCIENTIFIC NOTES AND NEWS

PROFESSOR HENRY FAIRFIELD OSBORN, president of the American Museum of Natural History, will retire from his office on January 1, 1933, on the completion of twenty-five years of service as president of the museum.

DR. SIMON FLEXNER, director of the Rockefeller Institute for Medical Research, has been elected a corresponding member of the French Academy of Sciences in the section of medicine and surgery. He replaces the late Charles Nicolle, director of the Pasteur Institute in Tunisia.

THE doctorate of laws was conferred on May 1, by the University of Michigan, on Dr. James Rowland Angell, president of Yale University. The late James Burrill Angell, father of Dr. Angell, was president of the University of Michigan for forty years.

ON the occasion of the installation of Dr. David Robertson as president of Goucher College, on April 24, the honorary doctorate of laws was conferred on Mrs. Herbert Hoover, in recognition of her work, in collaboration with the President, in translating from the Latin Agricola's "De Re Metallica." Degrees were also conferred on Dr. Winifred Clara Cullis, Sophia Jex Blake professor of physiology in the University of London, and on Dr. Florence Rena Sabin, member of the Rockefeller Institute for Medical Research. Addresses were made by Dr. Robert A. Millikan and by Dr. Cullis.

DR. WALTER DILL SCOTT, president of Northwestern University, and Mrs. Scott, also a graduate of Northwestern University, were the guests of honor at a formal banquet at the Blackstone Hotel, Chicago, on May 1. This banquet celebrated President Scott's tenth year as chief executive of the university, and took place on his sixty-second birthday. Dr. Scott

was previously for twenty years professor of psychology at Northwestern University.

DR. SIEGMUND FREUD, professor of neurology at the University of Vienna, celebrated his seventy-fifth birthday on May 6. A dinner was given in his honor on that day at the Hotel Ritz-Carlton in New York City. Dr. Freud, however, was unable to visit the United States.

DR. CHARLES E. PELLEW, adjunct professor of chemistry at Columbia University from 1897 to 1910, has been readmitted to British citizenship and has taken his seat in the House of Lords as Viscount Exmouth.

THE Royal College of Surgeons has awarded the Jacksonian Prize for 1930 to Edgar S. J. King, of the University of Melbourne, for his essay on "The Pathology of Ovarian Cysts and its Bearing on Their Treatment." The John Hunter Medal and Triennial Prize for 1928–30 was awarded to Mr. Layton, of Guy's Hospital, for his contributions to otology and for his valuable services to the museum, particularly in connection with the Onodi Collection. The Walker Prize for work on the pathology and therapeutics of cancer for 1926–30 was awarded to Sir G. Lenthal Cheatle, and the Cartwright Prize for 1926–30 was awarded to F. W. Broderick, of Bournemouth, for his essay on "The Etiology, Pathology and Treatment of Chronic General Periodontitis."

DR. FAY-COOPER COLE, professor of anthropology at the University of Chicago, has been elected president of the Geographical Society of Chicago.

THE thirty-sixth annual meeting of the Michigan Academy of Science, Arts and Letters was held in Ann Arbor on March 19, 20 and 21. The new officers include Dr. W. B. Hinsdale, professor emeritus of medicine and custodian of Michigan archeology in the University of Michigan Museums, *President;* Professor H. T. Darlington, director of the Botanical Garden at Michigan State College, *Vice-president.* Dr. L. J. Young, associate professor of silviculture, and Dr. E. C. Prophet were reelected secretary and treasurer, respectively.

DR. FRANCIS CARTER WOOD, New York, was elected president; Dr. Edward B. Krumbhaar, Philadelphia, vice-president, and Dr. William H. Woglom, New York, was reelected secretary and treasurer, of the American Association for Cancer Research at its recent meeting in Cleveland.

DR. WALTER RICHARD MILES, professor of experimental psychology at Stanford University, has been appointed professor of psychology at Yale University, where he has been research associate during the past year. Dr. Catharine Cox Miles has been appointed clinical professor of psychology.

DR. JOHN ALBERT KEY, at present assistant professor of clinical orthopedic surgery in the Washington University School of Medicine, has been appointed professor of clinical orthopedic surgery to succeed Dr. Leroy C. Abbott as head of the division of orthopedic surgery in the Washington University School of Medicine.

DR. EDGAR ANDERSON, since 1922 geneticist at the Missouri Botanical Garden and assistant professor at Washington University, St. Louis, has been appointed arborist of the Arnold Arboretum of Harvard University.

THE REVEREND JAMES BERNARD HENRY has been appointed director of the observatory of the University of Santa Clara, California, to succeed the late Jerome Ricard.

DR. ALFRED W. FRANCIS has resigned from Arthur D. Little, Incorporated, to join the research staff of the Vacuum Oil Company in Paulsboro, New Jersey.

MR. CYRIL AINSWORTH has been appointed assistant secretary of the American Standards Association. Mr. Ainsworth, who has been in charge of the association's safety code work during the past year, succeeds Mr. F. J. Schlink, who recently resigned to give full time to the technical direction of Consumers' Research, Incorporated.

Industrial and Engineering Chemistry reports that Dr. T. E. W. Schumann, since January 1 professor of mathematical physics at West Virginia University, Morgantown, has been appointed director of the Fuel Research Board of the Union of South Africa, and will take up his work there in June. Dr. Schumann was educated at the University of Stellenbosch in South Africa and at the University of Göttingen, and subsequently studied at Yale and at Columbia.

THE Committee on Scientific Research of the American Medical Association has awarded a grant to Dr. Maurice L. Cohn, who is collaborating with Dr. H. J. Corper, director of the Research Laboratories, National Jewish Hospital at Denver, Colorado, for the purpose of studying methods of cultivating tubercle bacilli.

DR. J. G. HUTTON, associate professor of agronomy at South Dakota State College, has been appointed chairman of the committee on soil conservation of the American Soil Survey Association.

DR. SAMUEL W. STRATTON, of the Massachusetts Institute of Technology, who has been in Europe, arrived in New York on April 29.

DR. CHARLES A. SHULL, professor of plant physiology at the University of Chicago, is spending the spring quarter carrying on research and lecturing at the Oregon State Agricultural College at Corvallis.

LEAVE of absence from Harvard University for the first half of the next academic year has been granted to Dr. Roland B. Dixon, professor of anthropology and curator of ethnology, and for the second half year to Dr. Walter F. Dearborn, professor of education and director of the psycho-educational clinic.

THE Gehrmann Lectures at the University of Illinois will be given on May 12, 13 and 14 by Dr. Alice Hamilton, of Harvard University, on "Recent Advances in Industrial Toxicology." Adolph Gehrmann was professor of bacteriology and hygiene at the University of Illinois from 1894 to 1918 and died in 1920. The lectureship was endowed by his family and the lectures are given each year on some phase of hygiene and public health.

THE sixteenth Mellon Lecture of the Society for Biological Research, of the School of Medicine, University of Pittsburgh, was delivered on April 23 by Dr. Florence R. Sabin, member of the Rockefeller Institute for Medical Research. Her subject was "Status of the Cellular Reactions in Tuberculosis." This lecture is given each year through the generosity of Mr. R. B. Mellon, who has provided an endowment fund, enabling the society to invite some eminent investigator in the medical sciences.

DR. EDWARD STARR JUDD, of the Mayo Foundation, Rochester, Minnesota, president-elect of the American Medical Association, gave the first address of the Mayo lectureship in Surgery of Northwestern University Medical School at the Murphy Memorial on April 22, on "Fundamental Problems Associated with Disease of the Biliary Tract." This lectureship was endowed by Dr. Charles H. Mayo, Rochester, for the advancement of education and learning in surgery. Every fifth year the lecture is to be given by a foreign physician, the intervening four lectures to be given by American surgeons.

PROFESSOR K. FREUDENBERG, of the department of carbohydrate chemistry at the University of Heidelberg, delivered a series of lectures on organic chemistry at Iowa State College on April 24 and 25.

DR. GEORGE K. BURGESS, director of the Bureau of Standards, delivered on April 18 a lecture before the Royal Canadian Institute on "The Bureau of Standards."

DR. R. A. MILLIKAN, of the California Institute of Technology, was the Chapel speaker at Iowa State College on April 19 and lectured the following day on "Cosmic Rays."

THE Edgar F. Smith birthday lecture will be delivered in the Harrison Laboratory of Chemistry of the University of Pennsylvania on May 22, at 4 o'clock. The lecturer will be Professor N. V. Sidgwick, of Oxford University. His subject will be "Atomic Cohesion"—a consideration of the forces by which atoms are attached in molecules, and molecules to one another in crystals, under different conditions.

DR. CHARLES N. FREY, director of the Fleischmann Laboratories, New York City, recently addressed the Purdue chapter of Sigma Xi on "Vitamins, a New Industry."

THE St. Louis University Sigma Xi Club held on April 30 a symposium on "The Structure of Matter" which was taken part in by James I. Shannon, S.J., professor of physics; Leonard F. Yntema, professor of chemistry; Franklin E. Poindexter, instructor in physics; Fred W. Laird, instructor in chemistry, and James A. McWilliams, S.J., professor of cosmology.

THE one hundred and seventy-first regular meeting of the American Physical Society will be held at the California Institute of Technology, Pasadena, from June 15 to 20, in affiliation with Section B of the American Association for the Advancement of Science. The Monday, Tuesday and Thursday sessions are to be devoted to symposiums of invited papers. On Wednesday the American Physical Society is invited to attend a session of invited papers arranged by the Astronomical Society of the Pacific in affiliation with Section D of the American Association. The regular meetings of the Physical Society for the reading of submitted papers will then come on Friday and Saturday.

REPRESENTATIVE workers in mollusks at a meeting of the Academy of Natural Sciences of Philadelphia have organized the American Malacological Union for the purpose of promoting the science and furthering the interests of students and collectors. Dr. Norman W. Lermond, curator of the Maine Academy of Science, was chosen as one of two secretaries and Dr. C. W. Johnson, curator of the Boston Society of Natural History, was elected treasurer. The new organization is planned to take the place of the former American Association of Conchologists, which has been inactive for a number of years.

THE American Dairy Science Association for the first time will hold its annual meeting on the Pacific Coast. It will meet in July, with the division of dairy industry of the University of California as the host. Dr. H. B. Ellenberger, head of the department of dairy industry, University of Vermont, is president of the association, and R. R. Graves, chief of the division of breeding, feeding and management investigations, Bureau of Dairy Industry, U. S. Department of Agriculture, is secretary-treasurer. The program committee consists of Dr. C. L. Roadhouse, head of the division of

dairy industry, University of California; Professor H. P. Davis, chairman of the department of dairy husbandry, University of Nebraska, and Professor M. Mortensen, head of the department of dairy industry, Iowa State College. This year's meeting will consist both of a formal program for the presentation of papers reporting recent progress in the dairy industry, and tours in the states of California, Oregon and Washington. The meeting will open on July 7 with a preconvention tour from Los Angeles. The formal program for the presentation of papers will be at the College of Agriculture, University of California, at Davis, on July 14. From Davis the tour will be continued northward into Oregon and Washington.

THE Eighth International Congress of Photography will be held at Dresden from August 3 to 8, the last day in Berlin. It has been organized by a committee composed of members of the German Committee of the "Commission Permanente des Congrès Internationaux de Photographie," of representatives of the "Deutsche Gesellschaft für Photographische Forschung," and of the "Deutsche Kinotechnische Gesellschaft." Professor Albert Einstein has consented to be honorary chairman and will open the congress with a lecture. During the congress general lectures will be given on the progress made in various departments of photography and cinematography. There will be special papers in four sections. It is proposed that on the last day of the congress the members shall have the opportunity of attending the making of a talking film at the Ufa studios at Neubabelsberg near Potsdam.

WE learn from the *British Medical Journal* that during the International Colonial Exhibition in Paris this coming summer there will be held a Congress of Tropical Medicine and Hygiene from July 22 to 31, under the presidency of Professor Tanon, who occupies the chair of hygiene in the Paris Faculty of Medicine. The subjects to be discussed include infant and child welfare; the anopheles and stegomyia problems; questions of food, drinking water, and intestinal parasitic diseases in tropical countries; emigration and the exclusion of epidemic diseases at ports; leprosy; the campaign against syphilis, and trypanosomiasis. Two days will be devoted to aviation in its public health aspects; Dr. Charles Richet will preside over this section, and there will be a special demonstration of various kinds of equipment. Attention will also be devoted to the French colonial health resorts. There will be a large number of official receptions and excursions to places of interest.

THE Society for the Prevention of Blindness has established a quarterly journal, *The Sight-Saving Review*, which will unite the scientific, educational, industrial and social forces striving to prevent blindness and conserve vision throughout the United States. The editor is Lewis H. Carris, and there is an editorial board consisting of Mary Beard, assistant director, International Health Division, Rockefeller Foundation; E. V. L. Brown, M.D., professor of ophthalmology, Rush Medical College; A. J. Chesley, M.D., Health Commissioner of the State of Minnesota; Charles L. Close, manager, Bureau of Safety, Sanitation and Welfare, the U. S. Steel Corporation; Gladys Dunlop, supervisor of braille and sight-saving classes of Detroit; Mary V. Hun, chairman, New York State Commission for the Blind; Edward Jackson, M.D., emeritus professor of ophthalmology, School of Medicine, University of Colorado; Albert B. Meredith, professor of education, New York University; A. L. Powell, manager, Eastern Office, Nela Park Engineering Department, General Electric Company; C. O. Sappington, M.D., director, Industrial Health Division, National Safety Council; William F. Snow, M.D., general director, American Social Hygiene Association; William H. Wilmer, M.D., director, Wilmer Ophthalmological Institute, Johns Hopkins University; Thomas D. Wood, M.D., professor of health education, Teachers College, Columbia University.

A PORTION of the summit of the Cascade Range and other scenic country has been added to Mount Rainier National Park. In addition to enriching the natural scenic features of the park and greatly increasing its educational features, this boundary change simplifies administration, protection and development of the park. It affords a natural boundary on the east, based on topographic conditions, and includes as the east park gateway Chinlook Pass, which affords an unusually spectacular entrance. Through it will run the new road connecting Yakima and Seattle. A factor in the addition to the park was the need for including in it the only feasible location for the new road to be built by the National Park Service to connect up with the new state highway on the east. All other possible locations were found to be excessively expensive. In all, a total of approximately 34,000 acres of land was added on the south and east boundaries.

THE new School of Public Health and Tropical Medicine at the University of Sydney has passed through its first year with considerable success according to a report in the *British Medical Journal*. The activities of the school include not only instruction and research in tropical medicine and public health, but also special education in school and building hygiene. Altogether 158 students attended during the year. Of these, 9 were medical graduates, 39 were medical undergraduates, 11 were students of

social hygiene, 9 were architectural students and 90 were graduate school teachers. Three diplomas in tropical medicine and two in public health were granted. The course in tropical medicine occupies a period of three and a half months, and corresponds closely to those of London and Liverpool. The faculty of medicine in the university has recognized the importance of the school by appointing its director, Dr. Harvey Sutton, professor of preventive medicine. This is the first chair in Australia in this branch of medicine. A hookworm and filariasis survey of Norfolk Island was undertaken during the month of January, 1931, completing the hookworm survey of the Australian Commonwealth, Papua and the Mandated Territory of New Guinea. This work, which was conducted for a period by the Rockefeller Institute in collaboration with the Commonwealth Government, has been carried on by the Commonwealth Health Department.

THE German Hygiene Museum at Dresden, which sponsored the International Hygiene Exhibition last year on the occasion of the opening of its new building, reports, according to *Museum News*, that 7,200,000 people visited the exhibition from May 15 to October 1, 1930. In view of the world-wide interest, the directors have decided to repeat the exhibition during the same period in 1931. Many of the foreign governments are enlarging their exhibits and it is said that the participation of the United States Government seems to be assured. In the museum itself the exhibits dealing with the health of the mother and child have been amplified and the exhibits on biology and comparative anatomy have been completely revised and enlarged. In anticipation of the exhibition, the museum has opened offices in several cities throughout the world. The American office is in charge of Dr. R. Woerner, at 1880 Broadway, New York City.

DISCUSSION

CRYSTALLINE PEPSIN OF NORTHROP

THE comprehensive investigation of Dr. Northrop on the crystalline pepsin prepared by him justifies the conclusion of the protein nature of this enzyme and makes probable the individuality of the crystalline substance. Its low isoelectric point stands out as the most characteristic property of the substance from the physicochemical view-point. It seemed to us of importance to detect some purely chemical characteristics of the crystalline pepsin, and with the consent of Dr. Northrop such an investigation was undertaken in this laboratory.

In course of the study of the products of hydrolysis of the crystalline pepsin which is now in progress, a peculiarity was found in the composition of this protein which differentiates it from any other protein, namely, the extremely small content of the basic components. Thus, the twice crystallized material contained only 4.65 per cent. of its total nitrogen in the form of basic substances. The significant feature, however, is that the material crystallized five times contained only 3.3 per cent. of its total nitrogen in the form of basic nitrogen.

The conclusion to be drawn, then, is that the crystalline pepsin, in the main, is an individual protein but it probably contains a small admixture of an extraneous protein. We are endeavoring to prepare the crystalline material free from the impurity.

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VITAMIN D IN WHOLE CORN

IN SCIENCE of January 23, 1931, Harris and Bunker[1] reported irregularity in the development of rickets in rats fed on diet No. 2,965 of Steenbock and Black.[2] The authors suggested that this may have been due to the presence of antirachitic factor in the corn contained in the diet.

It is true that of a group of rats fed on the same batch of diet No. 2,965 containing freshly ground whole corn, one or more animals occasionally fail to develop rickets, at least in the usual period of observation. This also holds true for diet No. 3,143 of McCollum,[3] if administered in the form in which it is usually prepared. But most investigators of experimental rickets have attributed this rather unusual occurrence either to a large store of antirachitic factor in such animals or to partial or complete inanition which interferes with the development of the disease. Another possibility that must always be ruled out is the contamination of the cage by a minute amount of very potent antirachitic substance (irradiated ergosterol) that may have been used in a previous experiment. Most investigators of the subject have now had this untoward experience. I am of the opinion that a fourth very likely explanation is the settling out of the calcium carbonate of the diet so that, as consumed by the animal, it does not have the high ratio of Ca to P which is a necessary condition for the production of rickets by this diet. Even if the diet is thoroughly

[1] R. S. Harris and J. W. M. Bunker, SCIENCE, 73: 95, 1931.
[2] H. Steenbock and A. Black, *J. Biol. Chem.*, 64: 263, 1925.
[3] E. V. McCollum, N. Simmonds, P. G. Shipley and E. A. Park, *Am. J. Hyg.* 1: 492, 1921.

mixed before serving, and is served fresh daily, the settling out of the calcium carbonate is still a very likely occurrence.

To avoid the settling out of the $CaCo_3$ and NaCl from diet No. 3,143 I have been in the habit of melting the gelatine it contains, in warm water (60 cc to every 15 grams of gelatine), incorporating the remaining constituents of the diet in this solution and stirring thoroughly until the mixture is a solid jelly. This insures the maintenance of the even distribution of the soluble and insoluble ingredients of the diet and keeps the ratio of Ca: P quite constant. A weighed portion of the jelly is served to the animal, and the residue is weighed after an interval of 24 hours to determine the amount consumed. It is easier to do this when the food is served in this form rather than in the form of a dry granular mixture, because the residue is in the form of one or a few dry masses which do not fall through the wire floor of the cage and can be easily separated from the feces. This form of diet No. 3,143 is eaten greedily by young rats and they develop a remarkably uniform degree of severe rickets in the usual period of four weeks.

Recently Shohl and Brown,[4] working with diet No. 2,965, modified by the addition of calcium or phosphorus compounds, so that the ratio of Ca to P was varied in a number of ways, obtained rather unexpectedly irregular results. Upon the assumption that the cause may have been the inconstancy of the various ratios of Ca: P, they have adopted the above method of maintaining them constant. They have effected this by replacing 6 per cent. of the corn in diet No. 2,965 by gelatine, and by incorporating the other ingredients in the jelly, as outlined above for diet No. 3,143.

It is not claimed that the results of Harris and Bunker[1] are accounted for by any of the explanations given above, but it seems timely to draw attention to some of the other possible explanations of the occasional irregular results obtained with rickets-producing diets served in the usual form of dry, granular mixtures, and to indicate a way of avoiding one of the causes.

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VIABILITY AND RETENTION OF VIRULENCE OF A CULTURE OF CORYNEBACTERIUM DIPHTHERIAE

IN December, 1928, a pure culture of *C. diphtheriae* was isolated from the throat of a patient. It fermented glucose and gave a typical virulence test in guinea pigs. The culture was grown on chocolate agar, placed in the refrigerator at the time of maximum growth, and transplanted every two weeks until June, 1929. At that time generous loopfuls of culture, each mixed with a drop of sterile rabbit's blood, were placed on each of a number of small bits of sterile filter paper, transferred to sterile Wassermann tubes, and kept *in vacuo* in anaerobic jars (Smillie) for a period of three months. The anaerobic jars were kept in an electric refrigerator.

In October, 1929, the culture was removed from the anaerobic jar, grown in meat infusion broth for twenty-four hours, and then planted on chocolate agar. It grew well, fermented glucose, and again gave a positive virulence test in guinea pigs. The culture was kept *in vacuo* for a second period of three months in the summer of 1930 and, when used for class work in December last, appeared to have undergone no loss of virulence.

It is known that *C. diphtheriae* survives preservation *in vacuo* after the method of Brown,[1,2] but it may be of interest to teachers to know that the culture will remain virulent under such simple conditions as those described.

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FORMALIN POISONING

FEW laboratory workers in the biological sciences have escaped some disagreeable experience with formalin. I know one pathologist who always wears gloves to hide the condition of his skin and another who should if he valued appearances. His hands are swollen, discolored and cracked. (Since I first wrote this he has gone into the hospital with a severe infection that started in these sores.) When I last saw my former anatomy professor he had both hands bandaged for formalin sores. I never heard that sinus or lung trouble had been traced directly to inhaling the fumes, but in some cases they are very irritating to the mucous membrane.

One of the worst features of formalin is the insidious and cumulative nature of the trouble it causes. A person may use it for a year or more before any symptoms appear; then the skin of the hands begins to dry, harden and form painful cracks that heal very slowly. Sometimes suppuration starts under the nails. After the victim has once become susceptible he generally has the trouble with him as long as he has anything to do with formalin. Rubber gloves give only partial protection, for a very slight exposure is enough to start trouble.

Formalin is such a useful laboratory reagent that it is almost impossible to avoid some contact with it. Aside from alcohol and water it probably has more uses than any other fluid.

[4] A. T. Shohl and H. B. Brown (unpublished).

[1] J. H. Brown, *Abs. Bact.*, 9, No. 1, 1925.
[2] *Ibid.*, SCIENCE, 64: 429, 1926.

When I asked a dermatologist if he knew any antidote or remedy he replied: "No, it is a good deal like a hot stove; you must keep your fingers off if you don't want them burned." I have tried ammonia, glycerine and various oils and lotions on my hands with only slight relief.

The purpose of this article is to appeal to the pharmacologists for a remedy; or still better to the organic chemists for some substitute, with which at a reasonable cost we may preserve our dogfish, kill and fix tissues, fumigate sick rooms, disinfect seed grain, poison the flies, etc., etc., while avoiding the irritating properties of formalin.

PHILIP H. POPE

WHITMAN COLLEGE

BASKING SHARKS ON THE PACIFIC COAST

THE staff of this station were interested in Mr. Gudger's account of the capture of a basking shark, *Cetorhinus maximus,* taken on the New Jersey coast near Long Branch, an account of which appeared in SCIENCE of October 3, 1930. We were interested not because of the strangeness of such a catch, but because so much space was given to an animal which is so common with us that we may see one almost any day during December and January.

Twenty-one of these sharks were sold to the Monterey Fish By-Products Plant, of Seaside, Monterey County, California, between the dates of November 22, 1930, and February 13, 1931, the average weight being 2,523 pounds. The largest was 6,580 pounds and 28 feet long, the smallest 900 pounds and 15 feet long. The largest shark sold to the above firm at any time was a few inches under thirty feet and weighed 8,600 pounds. The liver of this shark weighed 1,800 pounds, 60 per cent. of which was oil.

Because this fish feeds directly upon plankton, the oil is clear, odorless and tasteless when carefully prepared; and, in the writer's home, has been substituted for commercial cod-liver oil purchased at drug stores.

Little is known regarding the migrations of this shark on the Pacific Coast; in fact, little is known about it at all. It is a cold water form (which would be obvious because of its use of plankton for food), but it has been seen in numbers at different times of the year as far south as San Simeon Bay, California, and there are records of its having been taken at both San Pedro and San Diego. A 2,000 pound specimen was taken here at Monterey Bay, May 19, last year; and another, 26 feet long, 6,200 pounds, September, 1928; so apparently they occur all the year, but are most plentiful during December and January.

The reasons more of these sharks are not taken are that the price paid fishermen is only $2.50 per ton, and the animals are so difficult to handle that fishing crews do not feel justified in equipping their boats for taking them.

They are now used entirely for fertilizer or chicken feed, the liver oil being used in the preparation of the latter. No doubt *Cetorhinus* will be taken in increasing numbers when the real value of the oil is appreciated as a substitute for cod-liver oil.

Two parasite copepods, *Anthosoma crassum* and *Denemature producta,* were taken from the 6,200 pound specimen.

G. E. MACGINITIE

HOPKINS MARINE STATION

COLOR

SOME philosophers have discussed the question whether color is exclusively a mental phenomenon or whether it resides in a colored object. In the temporary exhibit of color organized by Dr. I. H. Godlove at the Museum of Science and Industry, New York City, there was exhibited a diagram which should help us to a better understanding of this problem.

The diagram has a red block in the center, a source of light on one side and the eye of an observer on the other. This shows that color, as connected with some definite object, is a complex phenomenon consisting of three elements. If any one of the three is missing there is no color. We have no right to say that the color resides exclusively in the mind, the object or the source of light.

We may well carry the analysis much further and distinguish the following items:

(1) A periodicity in the motion of electrons, atoms and molecules in the source of light. That we may have a red color this periodicity must vary within narrow limits on both sides of 500 000 000 000 000 periods a second.

(2) The passage of this periodicity from the source of light to the object in such a manner that the number of periods a second is accurately conserved, but with wave lengths and velocity dependent on whether it passes through a vacuum, air, water or some other transparent medium.

(3) If the source of light produces other colors than red, the object must absorb these and contain molecules which will respond to the periods of red light and send out in all directions light having only that periodicity.

(4) The passage of this selected periodicity to the eye.

(5) A change in the velocity of light as it passes into the eye of such a character that the light is brought to a focus on the retina.

W. A. NOYES

THE ORIGIN OF COSMIC RAYS

A PAPER which I presented at the Indianapolis meeting of the American Chemical Society has been erroneously reported in the Science News Supplement of SCIENCE; I do not wish to publish at the present time the details of this work, but I feel that there should be in the literature some compensating statement of my real views.

The paper under discussion dealt with the Millikan-Cameron theory of the origin of cosmic rays. According to this theory a cluster of electrons and protons is gradually built up and spontaneously collapses to form an atomic nucleus, emitting a cosmic ray. I pointed out that on the basis of our present knowledge this clustering process must be supposed to involve triple collisions, and that the rate of these collisions was insufficient by a factor of at least 10^{10} to give the observed cosmic ray intensities. The report to which I object omitted all reference to clustering and to triple collisions, and had me calculating the rate of simultaneous collision of 84 particles, retaining however the relatively small factor of discrepancy, 10^{10}, expressed more quaintly as ten million billion; it is certainly unfortunate that the writer of this account did not know that if I had ade the calculation to which he referred (as I have now done) I should have found a discrepancy not of merely 10^{10}, but of 10^{1700}, which could no doubt be expressed in some picturesque popular way by one sufficiently imaginative.

The account concludes with the statement that my calculations are based solely on the formation of iron atoms; this is not so.

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QUOTATIONS

THE CHEMICAL EXPOSITION

THE week of May 4 will find the Thirteenth National Exposition of Chemical Industries established in the Grand Central Palace in New York with as much space occupied as on former occasions and with a number of new exhibits. The exposition is more than an assembly of new and improved equipment, chemical products, raw materials of the chemical industry, and related items. Admittedly conducted as a commercial enterprise, the exposition nevertheless has become established as an important factor in the chemical life of America. Those familiar with the history of the exposition and the concurrent development of American chemical industry agree that the former has had a great influence upon the latter. It is well to recall that in those early days it was the exposition that served to emphasize the ability of our equipment manufacturers to provide the necessary devices with which to undertake seriously large-scale production of needed chemicals. It was to the earlier expositions also that manufacturers brought the first fruits of their efforts to show how successful they had been in a comparatively new and untried field. Those responsible for the advance of our chemical industry also came in numbers and found the opportunity to decide major questions after conversation with their colleagues.

The exposition is not without an enviable record of services rendered to the exhibitors. Orders approaching a quarter of a million dollars have been known to be placed with exhibitors during the exposition week, and some of the largest purchasers came from foreign lands to see and to buy. The publicity incident to the exposition's activities has been dignified and constructive, thereby adding its bit to our success in winning the sympathy of the general public.

There has been the educational side. Students, accompanied by instructors, have attended, but far more should make the most of the opportunity. However, those who have come—and the number has increased as we have gone along—have been able to see in the compass of a week more pertaining to their work than would be possible in weeks of travel to the various plants and warehouses. The students' courses have called for the cooperation of well-trained specialists, who have been glad to present discussions on topics chosen by the director of the students' courses to produce a well-rounded program and leave the lasting impression which comes from the receipt of valuable information.

The event is important from many points of view. That section of the public which comes in the evening can not fail to go away impressed with the fact that this industry, so little known prior to 1914, is now fundamental to public well-being and is conducted on a scale comparable with other commercial enterprises. There will be stockholders interested in more intimate details of the products of various concerns. There are sure to be bankers and financiers, executives and economists, journalists and teachers, among the crowds of plant operatives, technical men, and students. All are a part of the great army of ultimate consumers whom we seek to serve.

The exposition is an occasion of moment. It is a biennial opportunity to get abreast of new developments. It is one of the yardsticks by which we can measure our progress.—*Industrial and Engineering Chemistry.*

SCIENTIFIC BOOKS

Numerical Mathematical Analysis. By JAMES B. SCARBOROUGH, Ph.D. xiv + 416 pp. Johns Hopkins Press, Oxford University Press, 1930.

THE following statement in the preface characterizes the treatment of the subject almost perfectly: "The treatment of all topics has been made as elementary as was consistent with soundness, and in some instances the explanations may seem unnecessarily detailed. For such detailed explanations no apology is offered, as the book is meant to be understood with a minimum of effort on the part of the reader." Owing to this character the book will have friends who love it for its simplicity and lack of obscurities, and will hardly be useful to those who prefer to do some independent mathematical exploring.

The arrangement of the material is that of a textbook, with numerous completely treated examples in the text and problems for exercise at the end of each chapter. These examples and problems show a remarkable and pleasant versatility.

The subject of interpolation, numerical differentiation and solution of differential equations occupies over one half of the book. The formulas are all derived with elementary algebraical processes without any use of symbolic operators. It is especially in this part of the book that a somewhat higher mathematical standpoint would have saved pages of tedious elimination and would have brought out the mathematical beauty of the subject. Very illuminating are the discussions and examples pointing out the limitations of the formulas and processes. This part of the treatment probably surpasses that in any other existing treatise.

The other chapters deal with numerical methods of solving algebraical and transcendental equations, the theory of errors, empirical formulas and harmonic analysis.

In Article 106 the author objects to the frequently used method for computing the probable error of the result of the combination of different sets of measurements of the same quantity of which the probable errors are given. In the discussion he does not mention the circumstance that usually each set is affected by systematic errors of some kind which were not eliminated, so that the internal probable errors of each set are not a satisfactory indication of the accuracy of the result. This fact justifies and almost necessitates the usual practice of using the deviations of each set from the final result for the determination of the probable error.

The chapter on harmonic analysis deals exclusively with the cases of 12 and 24 ordinates. The efficiency of complete computation schemes which reduce the analysis to mechanical application of simple operations is not too strongly emphasized. In common with other presentations of this subject this chapter has the defect of not mentioning the use of a scheme for synthesis, and of not dealing with the case that arises most frequently; namely, the one in which only two or at most three harmonics are of interest, even though the number of data is much greater than twice the number of harmonics.

The book is beautifully printed; very few typographical errors were noticed.

DIRK BROUWER
YALE UNIVERSITY OBSERVATORY

The Organization of Knowledge and the System of the Sciences. By HENRY EVELYN BLISS, with an introduction by John Dewey. Henry Holt & Co., New York, 1929. $5.00.

THE reviewer was taught in his youth that science was organized knowledge of whatever kind. According to this definition, the book under review is thoroughly scientific. It is an instance of what can be done in the way of converting into a useful volume of reference what otherwise might have been an unreadable wilderness. The reviewer has attempted to read more than one treatise which might have profited by this good example.

The author, as a librarian, has had to do with the organization of knowledge of many kinds, as contained in books and deposited in libraries. In order to make this deposit available without undue loss of time, classification is necessary. It appears that in attempting to extend and improve this classification the author reached a limit set by the lack of a scientific classification in the various branches of knowledge themselves. The librarian is thus led to magnify his office and, like Lord Bacon, to take all learning for his province.

As instances of the breadth of the field into which the author's quest has led him, we may mention his discussion of the national and international organization of scientific men, of social, political and economic organizations, and their intellectual cooperation.

Not the least interesting feature of the book is the author's review of attempts to classify and systematize knowledge from Plato and Aristotle to Comte, Spencer and Wundt. An excellent bibliography with comments and summaries is given.

The work as a whole may be heartily recommended to those who are (or should be) interested in the relations of their own field of knowledge to the fields of others.

PAUL R. HEYL
BUREAU OF STANDARDS,
WASHINGTON, D. C.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A HIGH TEMPERATURE ELECTRIC FURNACE AND A MICRO-ADAPTATION

HOME-MADE electric furnaces are so much in vogue in American university research laboratories that a style of high temperature electric furnace which we have used with considerable satisfaction may be of interest to others.

For temperatures up to 900° or 1,000° C. a very inexpensive and practical electric furnace can be made by winding nichrome wire upon a grooved alundum core and suitably insulating it with two or three inches of magnesia or asbestos. For control a Thordarson A.C. regulator in series with the furnace has been found very satisfactory. It is desirable to have an ammeter also in the hook-up in series. Using number 17 (B&S gauge) nichrome wire a furnace core three inches in diameter can be held at 900° C. on about 10 or 12 amperes with three inches of asbestos packing. Or if wound in parallel with two strands of number 17 (B&S gauge) nichrome wire about 16 or 17 amperes will give the same temperature more rapidly. An ammeter, the scale of which reads to 10 amperes, is quite adequate for this type of work, making possible a highly satisfactory control for the lower temperatures. Such a meter may be shunted to read higher amperages.

For temperatures above 950° C. another heating element should be used. Platinum or one of the platinum metals is popularly selected. Since platinum has been shown to lose weight at the higher temperatures, around 1,500° C., we have resorted to the following expedient to cut down overload on the platinum heating element. An alundum crucible is wound with platinum wire and the whole is imbedded in a block of alundum cement. This is then introduced into the nichrome wound furnace. The mix is placed in a platinum crucible, which in turn is placed in the alundum crucible and covered with an alundum disc. But even with these precautions, it is necessary to proceed carefully to avoid the risk of burning out the platinum element at the higher temperatures.

Unless a rather large melt is wanted, a simple carbon resistance furnace is much preferable, as it is faster and requires less careful operation. Its main limitation is that only a small melt can be made, unless a very high amperage line and control unit are at hand. The furnace described below uses a crucible the size of one's little finger and of any convenient length, made out of an ordinary arc lamp carbon. It has been used on a maximum of 60 amperes A.C. 110 V. and is controlled by two 3 K.V.A., A.C. regulators. For this amperage the temperatures which we have been able to reach have been limited to 2,300° C. measured with a Leeds and Northrup optical pyrometer calibrated by the Bureau of Standards. Theoretically with higher amperage much higher temperatures should be possible, and with higher amperage larger crucibles could be used.

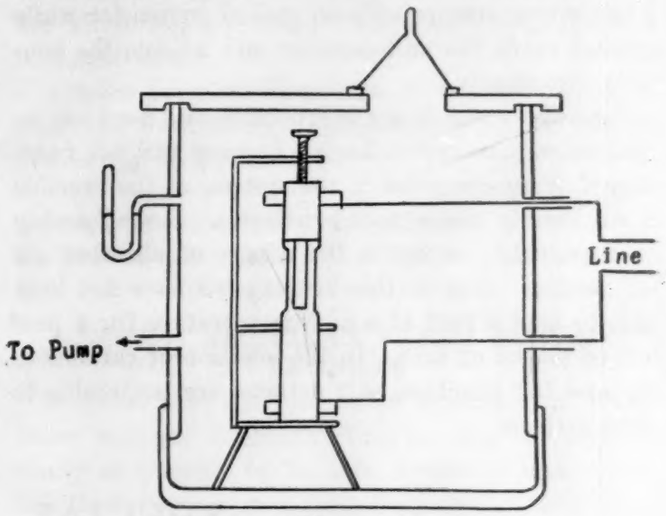


FIG. 1

The furnace itself (Fig. 1) operates under vacuum. It consists of a metal jacket cut from a piece of 8-inch steam pipe, threaded at one end, on which a cap has been tightly fitted. The other end was turned in a lathe to make it true, and on a metal plate a groove was turned to fit the open end of the pipe. Into this groove is fitted a rubber gasket, smeared on both sides with stopcock grease. In the top of the plate a two-inch hole gives a view of the interior. Over this hole is fitted a glass funnel with a similar gasket contact. Into the sides of the pipe have been fitted several ⅜-inch pipes, two of which serve to introduce the lead wires, one for the off take to a Cenco Hyvac pump, and one for a monometer gauge. Others are for special purposes. All seals are made with De Khotinsky cement. The crucible support within the furnace is made of "transite" board; the crucible—an arc lamp carbon drilled out at one end for the desired depth—is fastened into a collar by means of a set screw. The collar in turn is fastened to one of the leads. Another carbon, solid, similarly fastened into a collar and connected to the other lead, is placed on top of the loaded crucible carbon and is pressed into place by an adjustable spring. The crucible itself then offers the greatest resistance in the circuit, since its cross-section shows the smallest amount of conductor. It is therefore its own heating element.

The operation is as follows: After loading the crucible make sure that the upper carbon is in good contact with the top of the crucible to avoid arcing. Adjust the metal plate and gasket in proper position on top of the furnace, and suitably cover the window

opening. Start the vacuum pump and bear down upon the furnace top for a short time until it takes hold. Allow about fifteen minutes for pumping before turning the current on the crucible. The temperature of the crucible rises very fast following the ammeter quite closely. In fact, for careful melts we have found it desirable for one man to follow the crucible temperature with an optical pyrometer while another reads the milliammeter and adjusts the controls accordingly.

Crucibles so made are inexpensive and need not be used more than once. Such a furnace will not function if there are leaks in the system, as the crucible burns readily under such conditions. Some burning is unavoidable, owing to the release of absorbed air on heating. Due to this burning we have not been able to hold a melt at a high temperature for a prolonged period of time. In the selection of carbons to be used for crucibles, soft carbons are preferable to hard carbons.

A modification of this type of furnace has been used to determine melting points with moderate accuracy. Drill a hole in the side of an arc lamp carbon and place the material to be melted in the hole. Attach the lead wires to the ends of the carbon and support it on something such as transite board. The whole may then be mounted on a microscope stage and the melting observed while another observer reads the temperature with an optical pyrometer. Since this is not done in a vacuum the carbon burns rather rapidly but there is ample time for careful and deliberate measurements.

Others may have used furnaces similar to those described here. This description is offered at the suggestion of a visitor who expressed surprise that the higher temperatures could be reached so easily, and who believed that there were others who would be interested in these methods.

R. C. EMMONS

UNIVERSITY OF WISCONSIN

SPECIAL ARTICLES

THE STRUCTURE OF GLUCOSE

THE remarkable difference in stability and properties of the pyranose and furanose ring forms, respectively, of carbohydrates and polysaccharides points to some marked fundamental difference in their structure. This point of view receives added emphasis from the lack of a similar striking difference in properties between the five- and six-membered carbon rings.

The old von Baeyer strained ring hypothesis is no longer acceptable in the light of Ruzicka's synthesis of higher-membered lactone and ketone rings. There now appears to be definite evidence for the belief that while in the case of a pentamethylene strainless ring all the carbon atoms lie in one plane, in the case of hexamethylene, as first pointed out by Sachse and Mohr, a strainless ring is only possible if all the atoms are *not* assumed to lie in one plane; in other words, are united as a "puckered" strainless ring (A) or (A′).

It has been tacitly assumed, without any proof, however, that replacement of a carbon atom by oxygen does not influence the valence direction of the carbon atoms, and that the oxygen functions in this respect similar to carbon, namely, with an assumed normal valence angle of 109° 28′.

While it is true that certain X-ray data point to the tetrahedral character of the oxygen atom, the more recent work of Debye, of Sänger and of Williams serves to show that the valence angle of an oxygen atom attached to two carbon atoms, as in ethyl ether, is 32°, in other words, corresponds to that of the oxygen atom when linked with two atoms of hydrogen.

If now this latter value of 32° be taken as the *normal* carbon-oxygen-carbon valency angle, certain very interesting results follow.

For example, it is found that a ring system consisting of five carbon atoms and one oxygen forms a "puckered," strainless, pyranose ring (B). In this the carbon atoms are joined to one another at a (theoretical) valence angle of 109° 28′ and lie in one plane. The –C–O–C linkages with an oxygen valence angle of 32° subtend an angle of 109° 28′ with the plane of the carbon atoms.

On the assumption that in the furanose form (C) all the atoms lie in one plane, and that the *normal* –C–O–C– valence units form a much smaller oxygen valence angle than the system –C–C–C– (32° as compared with 109° 28′) such a ring must represent a strained system and one which should show a marked tendency to undergo ring scission, and ready conversion, under the influence of mild physical and chemical agents into the "puckered," strainless, pyranose ring type. That this must be the case is evident from the simple calculation, $360° - 3(109° 28′) = 31° 36′$, or the approximate angle suggested above for –C–O–C– linkage. It is not necessary to assume that the structure is that of a regular pentagon, inasmuch as the –C–O–C– linkage may represent some value smaller than that assumed in the regular figure.

The theory appears to offer an explanation of many abnormalities occurring between the various isomeric ring structures of carbohydrates and polysaccharides.

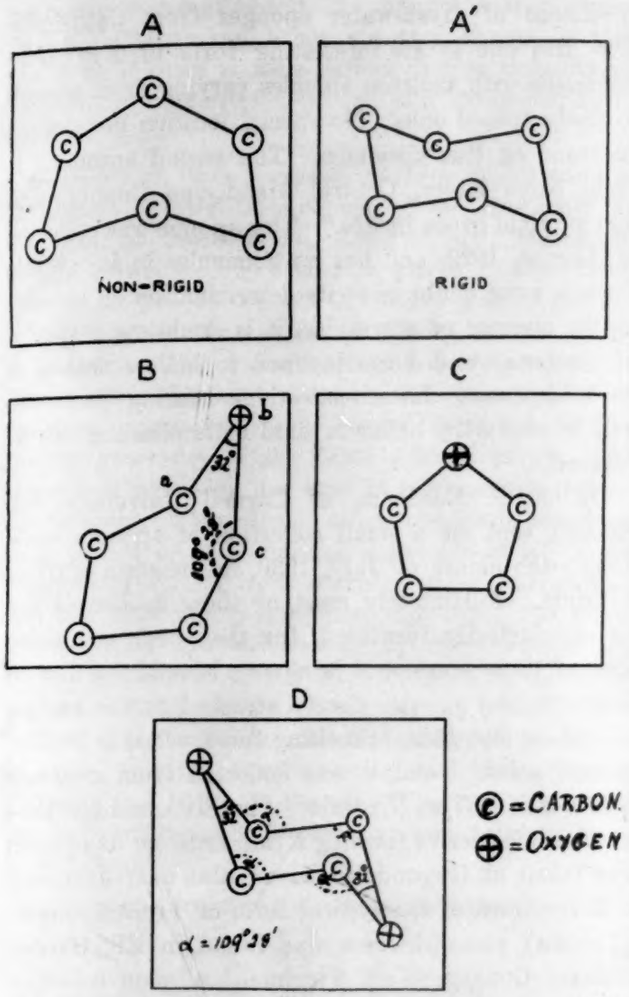


FIG. 1

The above ring forms may be readily demonstrated by use of the Goth carbon models. To represent an oxygen atom, two of the carbon valence bonds are removed from a carbon atom model and the two remaining valence units then bent over so as to subtend an angle of 32°.

It will be seen that in such a model (B) the passage from the "puckered," pyranose ring form into that of the Sachse-Mohr hexamethylene ring type is merely that of a transition of the valence direction of the oxygen atom from 32° to 109° 28′, this being shown on the model in very simple manner by the rotation of the oxygen-valence units *ab* and *bc* into the 109° 28′ position. In the case of the dioxane ring, containing two oxygen atoms, the new theory indicates a strainless ring structure for the compound, as represented by (D). It is seen that a perfectly symmetrical ring is obtained and one therefore having no dipolar moment.

The theory also offers an explanation of the well-known difference in properties found between ethylene oxide derivatives of carbohydrates and polysaccharides, and those of the trimethylene type.

The structures suggested above would seem to apply with equal force to other aldoses, to ketoses, polysaccharides, etc.

It is possible that the remarkable changes occurring in the character of the carbohydrate constituents during plant and animal cell metabolism are to be associated with the marked tendency of the furanose (gamma, active) strained ring type to pass over into the strainless, pyranose, "puckered" ring form as indicated above.

A more complete discussion of the theory is to be given in a forthcoming communication to the *Canadian Journal of Research.*

HAROLD HIBBERT

PULP AND PAPER RESEARCH INSTITUTE,
McGILL UNIVERSITY
(March 25, 1931).

NORTH AMERICAN FRESH-WATER SPONGES

IN order that the records of occurrence of fresh-water sponges in North America may be kept as nearly as possible up to date, I wish to make available the following notes upon the materials with which I have recently worked.

Some years ago while on furlough in South Carolina the writer collected several small bits of fresh-water sponges from a floating log in a fish pond near Summerton, South Carolina, and sent these on to the U. S. National Museum. They were, in the course of time, forwarded to Dr. Frank Smith, who identified them as *Trochospongilla horrida.* This find was of peculiar interest, both because it was, so far as I know, the first fresh-water sponge to be found in South Carolina and also because it was the second time this species, which is a comparatively common one in Europe, had been found in the United States. Dr. Smith had reported it from Illinois in 1921.

Dr. C. McLean Fraser, of the University of British Columbia, gave me a small bit of sponge which had been collected in October, 1925, in Beaver Lake, Stanley Park, Vancouver, British Columbia. This specimen is a typical form of *Spongilla lacustris.*

Professor Y. T. Chu, of St. John's University, Shanghai, China, while studying at Cornell University, Ithaca, New York, in 1925, sent me in September and October of that year two small specimens of fresh-water sponges, one taken from the fish hatchery at the university. This proved to be *Carterius tubisperma;* another from Beebe Lake at Ithaca has proved to be *Ephydatia mülleri* with heavy, smooth skeleton spicules. The opinion which places *Ephydatia japonica* as a synonym of *E. mülleri* is now generally, we believe, accepted. This sponge is very variable and *E. japonica* was separated from *E. mülleri* because it had smooth skeleton spicules: we now know that many specimens of this sponge contain

both the spined and the smooth skeleton spicules, thus providing connecting links between the two formerly supposed distinct species.

In March, 1927, Dr. V. M. Tanner sent me some small specimens of *Spongilla fragilis* collected in the Wasatch Mountains in Utah in a small fresh-water pond at an elevation of 7,800 feet. The gemmules of this sponge are found in two very distinct arrangements in different parts of the sponge: in one case, they are scattered through the sponge structure, being grouped together in the typical *S. fragilis* groups of from three to several gemmules with their pore tubes projecting through the covering layer of materials; in the other case, the gemmules form a continuous layer one gemmule thick, closely bound together by a layer of spongin through which the long pore tubes with their curved ends project.

Dr. Jacques Rousseau, of Quebec, kindly sent me several specimens of a deep green sponge forming short cylindrical growths independently and also around the stems of a water weed. This was collected August 8, 1926, and contained no gemmules, but is readily distinguishable by its form and its flesh spicules as *Spongilla lacustris*. This material was collected from Lake Montauban in Quebec Province. Later on, August 17, 1928, Dr. Rousseau also collected this same species at an elevation of 3,650 feet from Lake Cote, Shikshok Mountains in the Province of Quebec, Canada.

Dr. Charles P. Sigerfoos, of the University of Minnesota, has given me a specimen of sponge collected near Minneapolis, Minnesota. This was very full of gemmules and proved to be an *Ephydatia mülleri* with thin smooth skeleton spicules.

Professor W. H. Cole, of Clark University, Worcester, Massachusetts, has kindly sent me recently a collection of sponges which he made from Sudbury River, Concord, Massachusetts, in September, 1924. This sponge he had already correctly identified and reported as *Spongilla lacustris*.

Dr. S. F. Light, of the University of California, has kindly sent me on separate occasions two small specimens of fresh-water sponges from California. The first one is an interesting form of *Ephydatia fluviatilis* with skeleton spicules varying from smooth to finely spined ones. No special location nor date is recorded on this specimen. The second specimen is from Noyo River, Central Mendocino County, and was a "vivid green in life." This sponge was collected in August, 1929, and has no gemmules in it. While there is some doubt as to its determination on account of the absence of gemmules, it is doubtless a species of *Carterius* and I am inclined to believe that it is *C. tubisperma*. Later collections bearing gemmules will be necessary before a final determination can be reached.

Dr. J. G. Needham, of Cornell University, has recently sent me a small collection of sponges made during the month of July, 1930, in the state of West Virginia. Fortunately most of these specimens can be satisfactorily identified, for they bear gemmules. One of these specimens is a very beautiful lichen or liverwort-like growth closely attached to the surface of a stone as a thin, branching form. This is *Trochospongilla leidyi* and it was collected from a stream near Justice, West Virginia. Another small specimen of the same species forming a thin crust on its support was taken at Guyandotte River, also near Justice.

A specimen of the typical form of *Trochospongilla* (*Tubella*) *pennsylvanica* was found in Elk Garden, Mineral County, West Virginia. A good collection of green *Spongilla lacustris* growing in masses rather than in cylindrical projections was taken from Greenbrier River, Marlington, West Virginia. Another specimen of sponge was collected from the Cacapan River near Wardensville, West Virginia, but since this bears no gemmules and presents no distinctive characteristics to enable one to identify it, I shall not hazard a guess even as to its genus. The skeleton spicules are smooth, of medium size and bear sharp points at their ends.

N. GIST GEE

ROCKEFELLER FOUNDATION,
PEKING, CHINA

THE NATIONAL ACADEMY OF SCIENCES

AT the annual meeting of the National Academy of Sciences, held in Washington on April 27, 28 and 29, the following papers were presented:

Molecules in the sun's atmosphere: HENRY NORRIS RUSSELL. It was once supposed that the sun's atmosphere was too hot to permit the formation of chemical compounds, but six have now been detected over the photosphere and eight more above the spots. The heat of formation of a number of these compounds is known (from their band spectra) and their dissociation in the sun and stars can be discussed in the same manner as the ionization of atoms. The results are in good agreement with observation. In general, the compounds increase in number and amount at low temperatures. Most of the known compounds contain hydrogen—the most abundant constituent of stellar atmospheres. Oxygen—also very abundant—comes next on the list. The carbon compounds CN and CH show a maximum at temperature a little lower than the sun's. This may be explained if oxygen is in excess, for CO is more firmly bound than the other compounds, and at low temperatures most of

the carbon would go into it. In the cool stars of classes R and N the carbon bands are very strong, as they should be if there is more carbon present than oxygen (confirming a conclusion of the late Professor R. H. Curtiss).

Discovery of three thousand southern double stars at the Lamont-Hussey Observatory of the University of Michigan, at Bloemfontein, South Africa: MORRIS K. JESSUP (introduced by Heber D. Curtis). This observatory, initiated by Dr. W. J. Hussey and established in South Africa through the generosity of Mr. Robert P. Lamont, started a double star discovery program on May 8, 1928. Work at this and other observatories of American origin has been greatly furthered by the friendly generosity of the South African people. The program of observing has been largely concentrated on the discovery of new double stars, systematic searching being carried on to a limiting magnitude of 9.5 in the Cape Photographic Durchmusterung. Good pairs fainter than this limit were not rejected, however. The limits of separation are determined by the formula $\log p'' = A - Bm$, where $A = 2.8$, $B = 0.2$, and m is the visual magnitude of the primary. The observing has been done by three astronomers for the University of Michigan: Dr. R. A. Rossiter, chief observer, and Messrs. Morris K. Jessup and Henry F. Donner. The total production, soon to be published as a volume at Ann Arbor, is made up as follows:

Observer	Total discoveries	Known pairs remeasured	Total measures	Stars observed	Measures per star
Rossiter	1290	165	3336	1455	2.29
Jessup	988	436	3715	1424	2.61
Donner	738	265	2650	1003	2.64
L–H O	3016	886	9701	3882	2.50

Nights wholly or in part suitable for observing at Bloemfontein average about 250 per year.

The determination of the ozone in the upper atmosphere by bolometric measurements: OLIVER R. WULF (introduced by C. G. Abbot). Measurements of the transmission of visible light by ozone have been made on the solar spectrobolometer of the Smithsonian Institution at Table Mountain, California. A large glass cell, placed in the path of the sun's beam before the first slit of the instrument, was filled with controlled amounts of ozone and the weakening of the spectral intensity observed. Some forty satisfactory points for measurement have been chosen, scattered over the visible portion of the solar spectrobologram. These include points on both sides of the region of ozone absorption as well as within it. Using these, it has been possible to define a useful area which is proportional to the amount of ozone in the path, and which is determinable from transmission coefficients. This affords a basis for the determination of the amount of ozone in the upper atmosphere from direct bolometric intensity measurements.

Contact invariants: EDWARD KASNER. The author studies invariant properties of families of curves, or differential equations, under the total group of contact transformations. This includes the group of point transformations as sub-group (topological differential invariants as developed by Blaschke). Among families of ∞^3 curves, the *cubic type* is the simplest, including an interesting *anharmonic type* which is here introduced. Two families of ∞^2 curves (this configuration is termed a *wex*) have invariants. The simplest type of *wex* is defined by a generalization of the Desargues property. An absolute invariant of five differential elements of third order is found. Families of $\infty^2 + 3\,\infty^1$ curves are also introduced with a generalized hexagonal closure property. In conclusion, the author's theory of conformal invariants of horn angles is extended to both the topological and contact groups.

The present status of the telephone art in the United States, and some suggestions for future developments: GEORGE O. SQUIER. When Stephen Gray, an English scientist who died in 1736, discovered the copper wire to guide electricity he made one of the greatest inventions of all history. The telephone system in the United States now controls enough of this wire to reach half way from the earth to the sun. Under present management this vast wire pattern remains dumb and silent except for a few minutes each day. The present radio congestion in our planetary ether demands that Gray's invention be applied in furnishing educational programs free of advertising into the homes of the American people.

The effect of pressure on the quantum anomalies of ammonium chloride and bromide: P. W. BRIDGMAN. Simon has found anomalies in the specific heat of NH_4Cl and NH_4Br at atmospheric pressure at about $-30°$ Centigrade which are not allotropic transitions in the ordinary sense, since there is no change of crystal lattice, but which have been thought to be due to some quantum change, perhaps the acquiring of rotational energy by the molecule. Accompanying the anomaly of specific heat, there is also a volume anomaly of different signs in the two cases, the volume of NH_4Cl increasing anomalously as temperature is raised, while that of NH_4Br decreases. This leads to the expectation of a pressure effect, and this has, in fact, been found. At 0° Centigrade the anomaly in NH_4Cl begins at a pressure of 3,870 kilograms per square centimeter, and at 30° Centigrade at 9,390 kilograms per square centimeter. The transition is completed in a pressure range of about 1,300 kilograms at 0°, and about half this at 30°. A simple analogue of Clapeyron's equation governs the displacement of the transition. In NH_4Br the transition is displaced toward lower temperature by pressure, as would be expected from the opposite sign of the volume anomaly. At $-70°$ Centigrade the major part of the transition occurs at about 1,600 kilograms per square centimeter, and is very much more abrupt than

in the case of NH_4Cl. It will obviously require some modification in the simple picture of the mechanism hitherto described to account for the various differences in the behavior of NH_4Cl and NH_4Br.

Studies on electrokinetic potentials. IX. The electrical field of force at liquid-liquid interfaces: HENRY B BULL and ROSS AIKEN GORTNER (introduced by S. C. Lind). Apparatus was devised whereby the electrokinetic potential (the potential existing across the Helmholtz double layer) can be measured for an oil-aqueous solution interface using streaming potential technic. In its essential features the method consists of immersing two insulated platinum electrodes in a volume of oil and streaming a "rod" of water through a pin hole in one electrode so it passes through the oil and impinges upon the opposite electrode, imparting to it an electric charge. The difference in potential between the electrodes is then measured by means of a quadrant electrometer. The E.M.F. measured was found to be proportional to the hydrostatic pressure under which streaming was induced. The temperature coefficient of the potential was found to be appreciable. Potential curves were determined for the systems; refined paraffin oil (Nujol) and various concentrations of aqueous solutions of NaCl, $CaCl_2$, $ThCl_4$ and sodium stearate. Sodium stearate, sodium chloride and calcium chloride increased the electrokinetic potential at the interface in solutions of low concentrations, sodium stearate solutions being particularly effective. Higher concentrations reduced the potential somewhat. Thorium chloride solutions reduced the potential and reversed the charge from (−) to (+). The electrokinetic potential curves at oil-aqueous solution interfaces closely resemble electrokinetic potential curves at cellulose-aqueous solution interfaces or glass-aqueous solution interfaces. The measured potentials do not parallel interfacial tension changes.

Equilibrium theory of the cathode spot in mercury arcs: KARL T. COMPTON. The following considerations yield some definite information regarding the fraction of the current at the cathode of a mercury arc which is carried by electrons and show that the temperature of the cathode spot is so low that the electron emission can not possibly be of thermionic origin. The results therefore are in support of Langmuir's theory according to which the electron current from the cathode is a field current of electrons which are drawn out by the intense field concentrated there by the positive ion space charge. Four years ago Dr. Van Voorhis and the author presented to the academy a theory of the heat balance at the cathode. This theory is now extended by evaluating factors regarding which there was then insufficient knowledge. There are eight principal ways in which heat is fed into or taken away from the cathode. All these are now evaluated except for uncertainty in two quantities, one being the fraction of positive ions produced near the cathode which move, contrary to the applied voltage, toward the anode, and the other is the accommodation coefficient which measures the fraction of kinetic energy of a positive ion impinging on the cathode, which is delivered to the cathode. One equation which does not involve either of these unknown quantities gives a lower possible limit to the fraction of current carried by electrons. The other equation, which involves these two unknown quantities, gives an actual value for this fraction. Certain experimental evidence regarding these unknown quantities leads to the conclusion that the fraction of current carried by electrons at the cathode is certainly considerably in excess of 0.80. By applying equations of kinetic theory of gases to the observed rate of evaporation of mercury from the cathode spot, an equation relating vapor pressure to temperature at the surface of the cathode spot is obtained. By comparing this equation with the ordinary vapor pressure temperature relation for mercury vapor, unique values are found for the temperature of the cathode spot and the vapor pressure immediately outside it. These values depend on the value of the fraction of current carried by electrons, but the permissible values of this fraction show that the temperature of the cathode spot can not be higher than about 200° Centigrade. A consideration of the mechanism of ionization and of the pulling of electrons out of metals indicates that the ionization near the cathode must be of the cumulative type in which an atom is ionized by successive impacts of at least two electrons. These considerations enable us to plot a potential distribution curve for the region near the cathode which appears to be constant with all known facts regarding the mercury arc, although the distance scale on which this diagram is drawn can be fixed only between upper and lower limits. This theory appears to be equally applicable to the small mercury arc, such as that used for illumination and for the very large arcs now used in the metal tank rectifiers for electric railway operation.

Electron lenses: C. J. DAVISSON and C. J. CALBICK.

X-ray scattering by gases and atomic structure: E. O. WOLLAN and A. H. COMPTON. Measurements have been made of the intensity of the x-rays scattered at different angles by hydrogen, helium, oxygen, neon and argon. From these measurements the electron distributions in the atoms of helium, neon and argon have been found. For scattering by oxygen, neon and argon, a wavelength of $\lambda = 0.71$A, obtained by Ross' double filter method, was used. For hydrogen and helium it was necessary to use a single filter and an effective wavelength of 0.50A to get sufficient intensity. The scattering by the various gases was compared with that by hydrogen at 90 degrees, whose intensity can be reliably calculated. Electron distributions are calculated from these data for helium, neon and argon, using a straightforward application of Fourier integrals. The results can not be reconciled with Schrodinger's early interpretation of $\psi\psi^*$ as representing a continuous distribution of electricity, but are in excellent accord with the quantum mechanics predictions if $\psi\psi^*$ is interpreted as a probability of the occurrence of electrons.

Atom building in steps: W. D. HARKINS.

The rise of man and modern research: JAMES H. BREASTED.

Biographical memoir of John Fillmore Hayford (read by title): WILLIAM H. BURGER.

Biographical memoir of Stephen Alfred Forbes (read by title): L. O. HOWARD.

Biographical memoir of Ira Remsen (read by title): WILLIAM ALBERT NOYES and JAMES FLACK NORRIS.

Biographical memoir of Frank Austin Gooch (read by title): RALPH G. VAN NAME.

Biographical memoir of Thomas Burr Osborne (read by title): HUBERT BRADFORD VICKERY.

Biographical memoir of Robert Ridgway (read by title): ALEXANDER WETMORE.

Report of the National Academy Committee on the Grand Canyon project: JOHN C. MERRIAM.

Regarding definition of problems which concern evolution of man: JOHN C. MERRIAM.

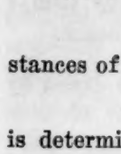
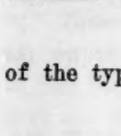
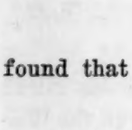
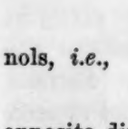
The discharge of hot springs in the Yellowstone Park: E. T. ALLEN. As a part of an investigation in the Yellowstone Park, carried on by a Geophysical Laboratory during the last six years, an attempt was made in 1930 to determine the aggregate discharge of water from the hot springs of this famous locality. The value obtained is regarded as a first approximation which may safely be compared with the volume of the cold drainages and with the measured discharge of other hot springs districts. In one important hot spring group, a long series of accurate measurements enables us to draw satisfactory conclusions regarding the constancy of the discharge. In another large basin the measurements, while fewer and less accurate, leave no doubt concerning the same question. The magnitude of the discharge in spring groups of different type is strikingly different. Inasmuch as the volume of the water is held to be a factor of first importance in the development of each type, this result has a special interest. From the values for the discharge and numerous analyses of the waters the magnitude of the dissolved mineral matter carried away by the water has been computed.

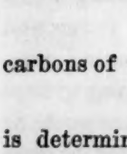
Fundamental scientific data resulting from geodetic surveys: WILLIAM BOWIE. The geodetic work of the Coast and Geodetic Survey has as its primary purpose the furnishing of geographic positions and elevations of thousands of points along the coasts and over the area of the interior of the United States as the bases for charts, maps, surveys, and many other engineering operations. The data resulting from these surveys are also of fundamental importance in science. It is by means of geodetic measurements of distances and angles and astronomical determinations of latitude and longitude that the figure of the earth can be determined. We know the figure of the earth, that is, its dimensions and shape, with a high degree of accuracy, but science is always striving for perfection. We have, in North America, connected geodetic surveys covering the United States and portions of Mexico and Canada, which will, in the near future, be used for a new determination of the earth's dimensions. The new value should have even greater strength than previous ones. By means of geodetic data, isostasy has been proved to be a scientific principle. According to this principle the irregular surface of the earth is due to varying densities in the crust below. Under the continents the material is less dense than it is under the oceans. The space within which these varying densities occur is limited by a level surface approximately 60 miles below sea level. The proof of isostasy leads to the definite conclusion that the interior of the earth is composed of material that is plastic to long-continued stresses. The geodetic data furnish a means by which varied structure, at least in its general outlines, can be discovered. This makes geodetic data of economic importance in searching for minerals. The accurate determination of geographic positions and elevations by geodetic methods enables one to test the stability of the earth's surface in any given region. The accuracy of the leveling, by which elevations are determined, is such that a closed loop of leveling has an error seldom greater than at the rate of 0.2 of a millimeter per kilometer of the distance around the circuit. In the triangulation, by which the geographic positions are determined, distances can be measured across country with an accuracy of one part in from two to four hundred thousand. It is readily seen that by repeating the observations from time to time the geodetic engineer can disclose any movements in position or elevation of the established stations. This method has been employed in California to detect what changes in geographic positions occurred at the triangulation stations near the San Andreas fault. This same method has been employed extensively in Japan to detect earth movements during earthquakes there. The observations made at the Variation of Latitude Stations at Ukiah, Calif., and Gaithersburg, Md., in connection with similar observations at stations in other countries, furnish data of fundamental importance to the science of astronomy. From the resulting data secured at these stations an estimate can be made of the rigidity of the earth. The triangulation and leveling of the United States are progressing rapidly. It is expected that the first and second order triangulation and leveling will be completed in the next twelve years. When this is done there will be few, if any, places in the country more than about 25 miles from a first or second order triangulation station or leveling bench mark. Intermediate areas will be covered by geodetic surveys of a lower order as the topographic mapping progresses. This expanded program of geodetic work of the U. S. Coast and Geodetic Survey is due to the initiative of President Hoover, who recommended to Congress that funds be provided for more rapid operations.

The physical basis of modern hydrographic surveying: A. L. SHALOWITZ (introduced by William Bowie). The

Great War was not only a landmark in the political and economic affairs of the world, but it marked, as well, the dawn of a new era in the application of the physical sciences to the problems of the hydrographic engineer. The possibility of utilizing sound as a means of measuring ocean depths and distances had been recognized long before this period, but no practical method had been evolved for meeting the exacting demands of modern hydrographic surveys. The investigations made during the war were quickly focussed on peace-time needs by the various maritime nations, resulting in this country in the development of the sonic depth finder by the U. S. Navy and later the fathometer by the Submarine Signal Corporation. With the development of sonic sounding came the Radio Acoustic Method of Position Finding, by means of which the positions of soundings are determined by measuring the time interval for a sound impulse to travel from the surveying vessel to two or more predetermined hydrophone stations near shore or at suitable points offshore. The application of acoustic principles to hydrographic surveying has been responsible for the rapid progress made by the Coast and Geodetic Survey, in the last few years, in the accurate and detailed charting of the waters along the Pacific Coast, and has made practicable the enormous Georges Bank undertaking. Through the instrumentality of the echo-sounding machine, an uncharted submarine valley, two miles wide, eight miles long and 1,800 feet deep, has been discovered on this bank, directly in the westbound transatlantic steamer lane and ideally oriented for vessels reshaping their course for Nantucket Light Ship. The paper discusses some of the problems entering into the acoustic method of surveying and shows the desirability and importance of knowing the path followed by the sound wave in its journey from the bomb to the hydrophone, particularly in an area where it is not feasible to determine the velocity of sound by direct methods. The paper presents the results of a study of the relationship between experimentally determined velocities of sound and theoretical velocities based on surface, mean and bottom temperatures of the water. The investigation indicates that the peak of the sound energy that reaches the hydrophone has been affected by physical conditions closely analogous to that obtaining at the bottom layers of water between the bomb and hydrophone. While the conclusions reached are by no means presented as a final product, this theory of sound-wave propagation, if substantiated by further experimental data, will have a far-reaching effect on future surveying operations and investigations.

The colloid chemistry of insanity: WILDER D. BANCROFT and G. HOLMES RICHTER. Insanity can be produced by suitable administration of peptizing agents or of coagulating agents. There are therefore two kinds of insanity, one in which the colloids of the brain are over-peptized and the other in which they are over-coagulated, insanity occurring when the brain colloids are far enough removed from the normal state. The coagulation form of insanity can be helped by treatment with dispersing agents, such as bromides or thiocyanates. The dispersion form of insanity can be helped by treatment with coagulating agents, such as cocaine or amytal. Probably caffeine would be still better.

Chemical structure and optical activity: P. A. LEVENE and R. E. MARKER. Previous observations of this laboratory have led to the conclusion that in simple substances of the type  the direction of the rotation is determined by the respective weights of the radicles R_1 and R_2. When in the arrangement of Fig. 1, $R_1 > R_2$ the substance is dextrorotatory. If R_1 is replaced by a polar group, as –COOH, then the latter group determines the direction of rotation and all substances of the type  are levorotatory. It was now found that the group  has an effect similar to a polar group and that the character of its effect is altered by the distance which separates it from the asymmetric carbon atom so that the members of the two configurationally related series of carbinols, *i.e.*,  and rotate in opposite directions.

It has been found further that in the case of hydrocarbons of the type  the direction of the rotation is determined by the respective weights of the groups R_1 and R_2. The changes in the numerical values of the rotations of individual members have been found to vary according to the rule of the "asymmetry product" enunciated by Guye so that in homologous series of hydrocarbons the direction and the numerical values of the rotation are predictable. In the case of hydrocarbons the effects of the isopropyl and of the isobutyl groups are analogous to those in the case of the carbinols. In a general way the conclusion has been reached that the rotation of a given substance is determined in the simplest case by the distribution of masses around the asymmetric carbon atom. In the more complicated cases when a polar group enters into the structure of a molecule the rotation is determined (1) by the respective weights of the masses surrounding the asymmetric carbon atom; (2) by the effect of the polar group, and (3) by the distance of the polar group from the asymmetric carbon atom.

The heat of combustion of methyl alcohol: FREDERICK D. ROSSINI (introduced by George K. Burgess). Be-

cause of its importance in the study of the equilibrium conditions of the reaction involving the synthesis of methyl alcohol from carbon monoxide and hydrogen, and because of the discordant nature of the existing data, the heat of combustion of methyl alcohol has been measured. In the present investigation methyl alcohol was burned at constant pressure in a reaction vessel in the calorimeter, and the thermal effect produced by the reaction was duplicated as nearly as possible with electrical energy. For the heat evolved in the reaction, $CH_3OH(g) + 3/2\ O_2(g) = CO_2(g) + 2H_2O(l)$, at 25° C. and a constant pressure of 1 atmosphere, the data of 9 experiments give the value of 763.77 ± 0.20 int. kilojoules per mole. Combining these data with those of Fiock, Ginnings and Holton on the heat of vaporization of methyl alcohol, gives, for the heat evolved in the reaction $CH_3OH(l) + 3/2\ O_2(g) = CO_2(g) + 2H_2O(l)$, the value 726.34 ± 0.20 int. kilojoules per mole at 25° C., 1 atmosphere. With the factor $\frac{1.0004}{4.185}$ these heat values are respectively 182.58 ± 0.05 and 173.63 ± 0.05 kg-cal_{15} per mole. The value given by Richards and Davis is 1.5 per cent. lower than the present one, while the recomputed data of Thomsen give a value in agreement with it, within the assigned limits of error.

Form factors in types of fish skulls: WILLIAM KING GREGORY. The study of over 200 different types of fish skulls leads the author to the conclusion that there is undoubtedly a regulating influence that adjusts the size and proportions of the head to those of the body as a whole in such a way that a stream-line normally results. The skull is subjected primarily to the growth forces that mould the body as a whole and these general growth forces affect the individual bones that lie in their paths; but the parts of the head themselves also have a degree of influence on the form of the skull; as each pair of main sense organs becomes enlarged or reduced, the corresponding parts of the skull change with them. The changing characters of the jaws and branchial arches have had profound effects upon the form of the braincase and the changing positions of the mouth in different types of fishes have had a great effect upon the jaw bones and the skull.

Contributions to North American herpetology; the frogs: ALBERT HAZEN WRIGHT and ANNA ALLEN WRIGHT (introduced by Leonhard Stejneger).

A new application of metaxenia through differential pollination: W. T. SWINGLE (introduced by R. A. Harper).

The character and inheritance of developmental differences in fruit shape: EDMUND W. SINNOTT (introduced by C. E. Allen). It has been shown that fruit shape in various plants is determined by genetic factors which are inherited independently of those governing volume or dimensions. These shape factors presumably control growth correlations. Their character and method of inheritance have thus far been studied chiefly by an analysis of differences in the shape of mature fruits. An investigation of fruit development, however, from ovary primordium to maturity, shows that there are marked differences in the manner by which fruit shape may be attained. Various pure lines, differing in fruit shape, were studied in *Cucurbita Pepo* and *Capsicum annuum*. In Cucurbita the shape index of the mature fruit is in most cases not widely different from that of its ovarial primordium, but in certain lines the fruit becomes progressively somewhat flatter as it develops. If shape index is plotted against volume, various inbred lines manifest marked and specific differences in the character of the curve produced. This may be essentially a straight line, differing only in pitch in different races; or it may show distinct concavities, the character and depth of which are also highly specific. In general, the slope of this curve is steeper in races which have a relatively "flat" fruit shape. Certain lines, between which the major shape difference is due to a single genetic factor and which are also clearly different in the slope of their developmental curves, were crossed. It was found that the F_1, whatever its shape index, was usually intermediate in the slope of its curve, and that the members of each of the two segregating shape types in the F_2 showed a considerable variability in the slopes of their developmental curves. Other lines, essentially similar both in shape index and in development, differ markedly in the ability to transmit their specific developmental characters to their progeny in crosses with other lines. Crosses between two lines each showing relatively flat developmental curves may produce offspring with markedly steeper ones. Capsicum differs from Cucurbita in that the ovarial primordia in all types are very similar. The growth of the flat, the isodiametric and the elongate fruit types from these primordia involves profound developmental differences. An understanding of the manner in which genetic factors determine fruit shape must evidently depend upon a study not only of the mature structure itself but also of the changes undergone during its developmental history.

Stimulation by alcohol: W. J. V. OSTERHOUT and S. E. HILL. Alcohol is able to produce electrical changes in plant cells and hence to start and stop action currents: it therefore acts as a stimulus and as a block.

The effects of deprivation of manganese on the rat:[1] E. V. MCCOLLUM and ELSA R. ORENT. Rats restricted to a diet which is essentially free from manganese grow normally. They begin to produce litters at the normal age. The young are born alive. The mothers do not build a nest or collect their young or hover over them, and the stomachs of day-old young never contain any milk, and the young die from neglect. Vaginal smears show that the adult females go through the normal estrual cycle and if kept with normal males their fertility approximates that of normally fed rats. These mothers with one exception declined to nurse their own young and did not care for foster young from the stock colony.

[1] From the Department of Chemical Hygiene of the School of Hygiene and Public Health of the Johns Hopkins University, Baltimore, Maryland.

In tests with about one hundred young from manganese-free mothers only one animal was reared by stock females which had just delivered litters, whereas exchanging young of stock mothers does not result in lack of maternal solicitude. It appears that the normal mother detects something wrong with the young of manganese-free mothers and abandons them. This happens even when the young of manganese-free mothers are wrapped in cotton with normal stock litters of new-born for an hour or more for the purpose of putting the odor of each kind of young on the other before placing them with the stock mothers. Histological studies are being made of the mammary tissue at different stages of gestation, to determine whether there is any development preparatory to milk secretion. The addition to the manganese-free diet of as little as five thousandth of one per cent. of manganese results in preventing the behavior of the female rats toward their young. With this addition they care for their young normally and have almost no infant mortality. Male rats kept on a manganese-free diet show no abnormality other than testicular degeneration. This degeneration is well under way by the hundredth day on the diet. The atrophy then rapidly proceeds until only vestiges remain and complete sterility results. The histological changes at different stages of degeneration of the testes will be described later. There is little or no tendency to obesity in these males. The testicular atrophy and the failure of females to suckle young suggest failure of some hormone production in the hypophysis. There is a clinical literature on male sterility developing in middle life, which is referred to hypophyseal deficiency. There is likewise recognized by endocrinologists a stimulating effect on milk secretion caused by the administration of certain hypophyseal extracts. Observations thus far made seem best explained on the theory that manganese is in some manner related to hormone formation by the hypophysis. The problem is being studied in detail.

New methods for locating genes in particular chromosomes: ALBERT F. BLAKESLEE. The usual method of locating genes is by linkage between two or more genes in disomic inheritance. The newer methods developed in Datura include the following: (1) All the 12 primary (2n + 1) types when heterozygous for a given gene throw disomic ratios in their offspring except the type whose extra chromosome carries the locus for this gene. This latter primary throws trisomic ratios. By trisomic ratios from (2n + 2/2) secondary types, from (2n + 1) tertiary types with a compound chromosome extra, and from extra fragment types, genes may be located in particular parts of chromosomes. (2) Compensating types, in which parts of two chromosomes compensate to form the equivalent in genic content of a whole chromosome, if heterozygous for a gene with its locus in the compensated chromosome will breed true for this gene among its 2n offspring, except for crossing over. Double compensating types are known which compensate for two different chromosomes. (3) Types with a translocated fragment, which enables the plants affected to be recognized by external characters, if heterozygous for a gene with its locus in the chromosome to which the fragment is translocated, will breed true for this gene among its 2n offspring, except for crossing over. (4) Prime types (types with chromosomes modified by segmental interchange) if they induce a definite proportion of aborted pollen in the heterozygous condition may be used to locate genes by ratios of individuals in the offspring with good to those with characteristic percentages of aborted pollen. This method locates the gene in one of two chromosomes if the prime type has two chromosomes modified. (5) If a plant heterozygous for a gene which causes abortion of one half the pollen grains but which does not affect the vitality of the egg cells is rendered heterozygous for a non-lethal gene, all the offspring from the male back-cross will be homozygous for the gene, except for crossing over. In the usual method of locating genes by linkage, the crossing-over values are determined by the interaction of two genes with loci in the some chromosome. By the methods 1, 2, 3 and 4, here given, the crossing over of a given gene can be determined without regard to the behavior of a second gene.

A new travertine-forming organism: MARSHALL A. HOWE. The geological importance of certain aquatic plants known in a general way as the algae has received increasing recognition during the past twenty-five years. Not only have certain so-called "coral" reefs been found to have been built up by lime-secreting plants rather than by lime-secreting animals, but many fresh-water deposits of lime, both recent and fossil, have been found to be due chiefly to the peculiar activity of minute plants belonging to the group known as the blue-green algae. The speaker described in particular a very minute lime-precipitating organism of bacterial dimensions that is responsible for the formation of concentrically layered pebbles and sometimes more extensive deposits of limestone that occur in "hard-water" streams of Pennsylvania and West Virginia. This organism, geologically important, is believed to be new to science.

(To be continued)

BOOKS RECEIVED

BLANCHARD, W. O., and S. S. VISHER. *Economic Geography of Europe.* Pp. ix + 507. 331 figures. McGraw-Hill. $3.50.

CHAMOT, ÉMILE M., and CLYDE W. MASON. *Handbook of Chemical Microscopy.* Volume II, Chemical Methods and Inorganic Qualitative Analysis. Pp. ix + 411. 181 figures. Wiley, $4.50.

HACKH, INGO W. D. *Structure Symbols of Organic Compounds.* Pp. viii + 139. 29 plates. Blakiston.

MEIER, W. H. D., and LOIS. *Essentials of Biology.* Pp. vii + 529. 332 figures. Ginn. $1.68.

MILLER, EDWIN C. *Plant Physiology.* Pp. xxiv + 900. 38 figures. McGraw-Hill. $7.00.

SIMONSEN, J. L. *The Terpenes.* Volume I, The Simpler Acyclic and Monocyclic Terpenes and their Derivatives. Pp. xv + 420. Cambridge University Press, Macmillan. $8.50.

SMALLWOOD, JULIAN C., and FREDERIC W. KEATOR. *Mechanical Laboratory Methods.* Fourth edition. Pp. xii + 386. 121 figures. Van Nostrand. $3.50.

STRECKER, EDWARD A., and FRANKLIN G. EBAUGH. *Practical Clinical Psychiatry for Students and Practitioners.* Third edition, revised. Pp. xvii + 553. 47 illustrations. Blakiston.